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WORLD CROPS

The International Journal of Agriculture

VOLUME 13, No. 5 MAY 1961

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WORLD CROPS

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BETTER HARVESTS ROUND THE WORLD

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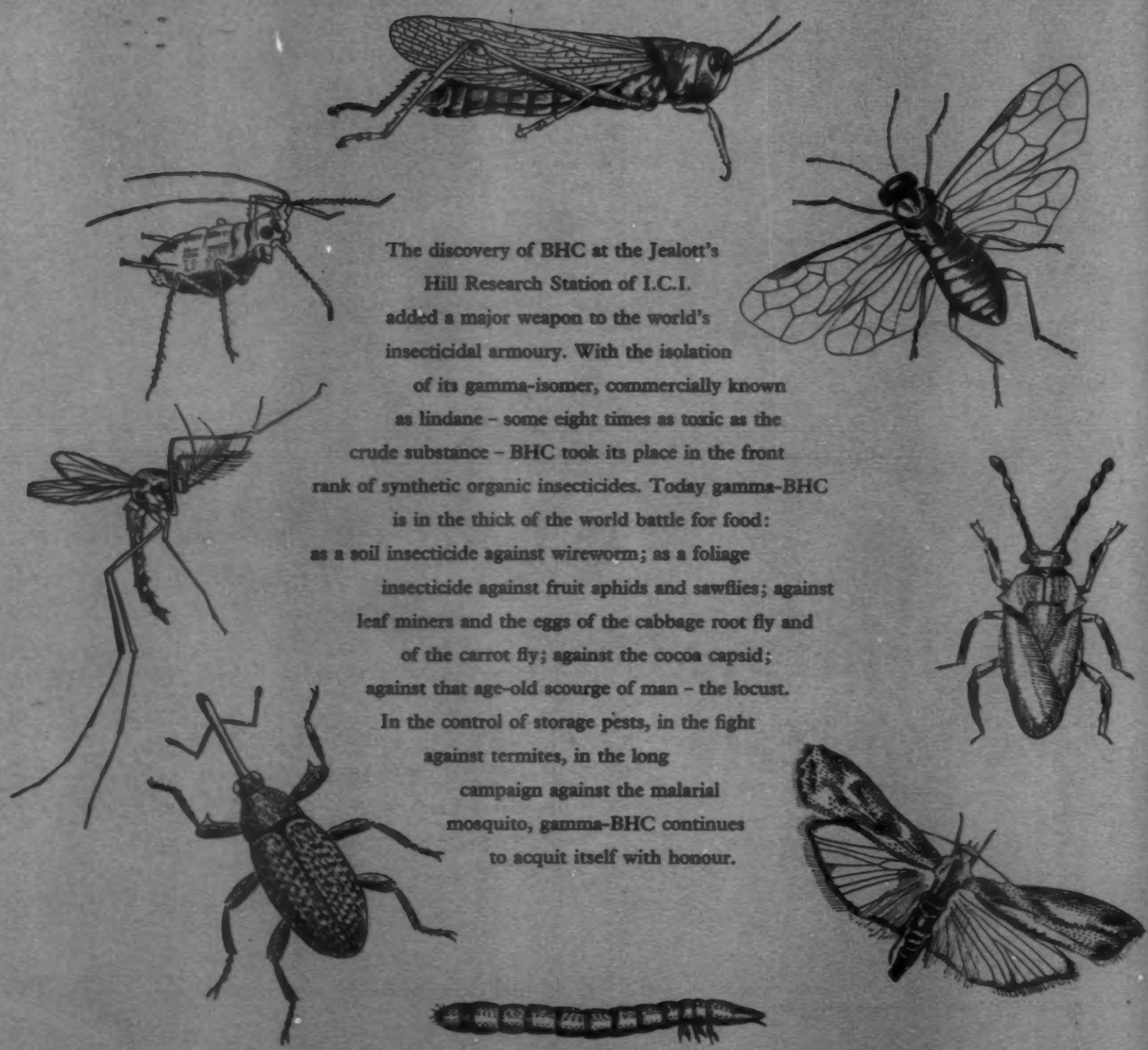

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Editorial Comment

Correct Land Use

Accent on Agriculture

'What is Truth?' said Jesting Pilate,
And would not stay for an answer.

Francis Bacon (1561-1626)

THE WORLD IS TODAY so bedevilled with politics that we are apt to lose sight of the main objective, which is to continue to produce enough food to meet the ever-increasing requirements of the mounting millions. This problem should transcend all others.

Sir Edmund Stockdale, the previous Lord Mayor of London, speaking to the Agricultural Engineers' Association, said that ' . . . in 1958 over 2 million of the world's population died either directly from starvation or from diseases that could have been avoided had they been properly fed. In spite of this horror, total world population increased by 47 million. At this rate, it will double every 50 years . . . so, too, must the food supply.

'*In 150 years from now*—that is within the lifetime of our grandchildren—*the world must have increased its food supplies to eight times the present quantity.*

'Going back 150 years, Britain, then without doubt the leader of the world in agricultural techniques, had taken five centuries to treble its grain yields. Even in the last 100 years, in spite of all the benefits of modern science, overall agricultural yields throughout the world have increased by only 60%.

'Whatever political considerations may become involved in this international fight against hunger, this fact will remain: countries, such as Britain, have a duty to provide all the means within their powers so that misery caused by lack of food can be eased as far as possible . . . '

This is a re-statement of what has been repeatedly emphasised in our editorials. The truth is that over two-thirds of the people in this world are under-nourished, and that *food production in the backward countries is not increasing as fast as their already under-fed populations.*

We must not be reassured by statements such as that which appeared in the 'State of Food and Agriculture, 1960', to the effect that preliminary estimates indicate that . . . the rise in world agricultural production in 1959-60 was about 2%, a little more than the estimated annual population growth of 1.6%. Such statistics merely average up the position of surpluses in the advanced agricultural countries against growing deficiencies in the backward agricultural countries. More food must be produced in these heavily-populated regions, otherwise there must be a population reduction by starvation, disease or war.

Revolution in Agriculture

DURING THE PAST 100 YEARS the British, French and Dutch built up a vast agricultural scientific service of men who worked in the arduous conditions of those days to develop the undeveloped and under-developed areas of the globe and at a time when there were none of the modern aids to agriculture. It was slow and often uphill work. Yields were increased, new lands were opened up and new crops were introduced—such as rubber, tea, coffee, maize, cotton, jute, sisal, pyrethrum, sugar, pineapples, corn, tobacco and rice.

In the last 15 years, with the rapid spread of self-government, this service of scientific specialists has atrophied. Its place has, in a manner of speaking, been taken by the officers of FAO, but they serve only in an advisory capacity—and only for short terms—in the countries which have asked for their services. Such a general, impersonal service, with no executive powers, falls far short of the operations of the former colonial agricultural services it is vainly attempting to replace, and for financial reasons, too, it is quite inadequate at a time when a revolution in agricultural methods is taking place.

If the productivity of the backward areas is to be increased several-fold, commensurate with the population increases, some serious rethinking will be necessary.

What is Wrong?

WHAT IS WRONG? Why is it that the gap between the East and West is growing? Why is it that the sound advice offered by the experts and specialists of FAO is, for the most part, so little heeded? Why is it that the productivity of the under-developed countries is not advancing at a rate commensurate with the increase in their populations?

There are four main reasons: First we would place politics—meddling not only by three of the great powers, but also by the governments of other newly self-governing countries, who make their voices most loudly heard in the councils of the United Nations while the economic progress of their own countries is at a virtual standstill. Hence we have used the expression 'Bedevilled by Politics'. Today there is growing world chaos.

The second reason is that the pace of self-government has been so irresponsibly rushed that it has not been possible to find sufficient numbers of adequately qualified leaders in these countries and train them in the art of effective leadership. The result is that senior

men are in jobs that they are not fitted to hold, while the men who have been sent overseas for special training are frustrated and have not the power to get on with the job of reshaping and re-forming the agricultural economies of these backward agricultural countries. All this, say the optimists, will sort itself out, but the fact is, it is not doing so.

The third reason is that priority has not been given to agriculture; there has been over-emphasis on industry, whereas, as Mr. Atwood, of Eire, points out in this issue, the advanced nations in the West have all found it desirable to give active encouragement to their agriculture; the success of their policies has been an embarrassment which the governments of the less developed countries would be only too delighted to experience.

The fourth reason is faulty land use. The Western system of democracy which has been adopted by these countries is not only not understood, it is actively abused, for it has degenerated into a system of one man, one acre, one vote.

In a misguided policy to maintain employment, large estates are being broken down and the smaller farms and holdings are being allowed to be fragmented by the system of inheritance, all leading to a form of subsistence agriculture whereby a favoured peasant farmer or a new colonist—who is so often an alien on the land—is able to produce little more than is enough for himself and his family. In these circumstances it is only possible to apply modern methods and modern machines on a limited scale quite inadequate to meet the needs of the people. *The first purpose of agriculture must not be to provide jobs, but to provide food and still more food.*

What is Right?

So far we have been destructive. Now we need to make an appraisal of the position which has been reached in various countries with regard to land tenure in order to be in a position to offer some sort of solution to the agricultural and economic problems, which will inevitably become more acute with soaring populations.

The first requirement is to make some attempt to control populations. This is not a problem which primarily concerns agriculture; nevertheless, because each new mouth must be fed, it does indirectly concern us all. China is a country with a mounting population pressure and its agriculture, in spite of a heroic national effort, has failed for two successive years and the position is grim.

The next consideration is—which system of agricultural government is producing the best results and is best able to apply modern methods which alone will be able to increase the productivity of the earth eightfold in the next 150 years? We can rule out the 'little man'—the peasant farmer—right away; there is absolutely no future for the world in this system of agriculture. There must inevitably be some form of organised agriculture, but which is it to be?

In this category there are: the system of ancestral estates with tenant farmers (which is passing); the plantation system with well-organised labour forces (which is producing results); the large owner-operated farms of Europe and America (which are mainly responsible for the progressive agriculture of the West); the system of co-operative farming with individual ownership (which is so successful in Denmark); collective farming with individual ownership (which is going ahead in Yugoslavia); collective farming and State farming without individual ownership (both of which after 40 years of trial are showing colossal failures).

Success in Agriculture

What is the characteristic of success? It is, quite frankly, self-interest; and the characteristic of failure is the lack of personal incentives. Intense patriotism, devotion to an idea and the mass recitation of slogans can produce a magnificent initial effort until the effect of this mass hypnotism begins to pall and the individual begins again to think for himself.

The recent failures of the collective farm system may be in part due to officials who have been made the scapegoats, but the real cause of the failure lies with the individual farmer or the worker on the land, who is being dragooned by the system of plans into producing results without adequate incentives. He is given a tractor, but it is not his own and at the end of a tiring day will he care for it with the loving care of a man who owns that tractor? The result is that, through the inevitable breakdowns, the allocation of tractors will not be adequate to requirements and the ambitious five-year plan must inevitably fail.

Obviously some form of organised agriculture is essential if the future food and raw material requirements of the world are to continue to be met, but some form of personal incentive also is essential. We recently inspected a new form of agricultural organisation—Co-partnership Farms Ltd.—established on the site of an abandoned war-time aerodrome in Kent. There is an overhead administrative machine which plans and organises the work, the purchases of farm equipment and supplies, and the bulk sale of the produce of the participants, who all share in the profits on an agreed basis. This system appears to offer both the necessary organisation and the incentive and we shall watch its progress with interest.

Difficulties of Small Farming

In the August 1959 issue of World Crops we commented on the difficulties of the small farmer in Britain in this age of scientific agriculture. But some countries have a far worse problem in that the farm holdings are

very small indeed or, even worse, are held in multiple ownership. In many tropical countries the holdings are less than 15 acres in size, the majority are between 3 and 5 acres, and a very large number are even smaller —in some parts of India a single acre, a row of coconut trees, or even the crop from a single tree may be shared. The position worsens as the people continue to multiply in consequence of the vastly improved health services.

In these circumstances little more than a subsistence or selfish agriculture is possible at a time when more and still more food is urgently needed in these countries. While it is possible to open up new agricultural lands in some countries, the clearing, drainage and breaking in of virgin jungle, often far removed from established towns and villages, is a major undertaking, involving the use of modern methods and machinery.

Then, after the land has been cleared, it must be colonised. This is usually quite easy, particularly where there is land hunger and an effective administrative machine. The major problem is to keep the settlers on their smallholdings and this, surprisingly enough, is not always such an easy matter. The tendency is for them to lease or sub-let their lands and go back to live with their relatives and friends in the overcrowded towns and villages from whence they came.

Ultimately colonisation schemes, launched with much pomp and ceremony, cease to be mentioned in annual reports, for they have become overgrown with jungle and almost totally abandoned . . . the ephemeral politicians come and go and their policies and plans are forgotten and the downward trend in agriculture continues.

Effect of Farm Size

THERE WAS MUCH FOOD FOR THOUGHT in the article by A. B. P. G. Behr, which appeared in our March and April issues. During the past five years he has had special opportunities for making a close study of agricultural conditions in India and his considered verdict is that the policy of reducing the size of agricultural properties to a ceiling of 25 acres will lead to economic disaster.

The prevailing tendency towards an agricultural economy, based on the 'little man', which is going on in several countries may satisfy the immediate land hunger of the electorate, but it is quite unrealistic as a long-term policy, for it is not conducive to higher productivity to be obtained through the effective application of modern methods and machines, which has produced such vast surpluses of cereals in America, Canada and Australia.

In over-crowded Britain, strangely enough, there is no land hunger of the type to be found in African and Asian territories; the tendency is towards making the farms larger, not smaller, and everything is being done to help the farmer to make each acre of land more productive. Using the devices of modern agriculture, Britain has increased her grain yields eight times since the days of peasant agriculture. This is the world target for today.

It could be argued that a small allotment can be made more productive by concentrated attention by an expert agriculturist than a similar area of a large farm. But the peasant farmer is not an expert and he cannot be helped except in small ways, and he is too easily satisfied with small returns sufficient to satisfy the humble needs of his family. It is impossible to organise the effective marketing of tiny lots of produce on co-operative lines and the result is he is at the mercy of the village trader, particularly if his position is complicated by chronic indebtedness.

Correct Farm Size

In Britain small farms below 50 acres (other than specialist enterprises, such as mushroom growing) operate at a loss when the value of the farmer's own labour is taken into account, according to a sub-committee of the Natural Resources (Technical) Committee, whose report* is issued from the office of the Minister of Science.

Actually the proportion of very big farms is small, for two-thirds of all the farms are between 15 and 100 acres, and holdings of under 100 acres are responsible

* *Scale of Enterprise in Farming.* Natural Resources (Technical) Committee. 1960. H.M. Stationery Office, 6s.

'Help!'

for nearly half the agricultural production in England and Wales. The problem is not so much that farms are too big, but that they are too small for efficient operation on modern lines.

Apart from the feeling of freedom and the non-material benefits of owning a small farm, the average farmer of 50 acres or less is no better rewarded than a farm labourer and there is always the ever-present risk of bankruptcy through successive crop failures. In Asian countries this corresponds to the heavy burden of indebtedness which is carried by almost every peasant farmer.

There is perhaps one over-riding argument in favour of the small farmer—it is the simple argument that he likes doing it, for it is the sort of life he wants, and if he can make a living at it, he is prepared to put up with pretty low standards.

Flying Crane

IN OPENING UP NEW AREAS for agricultural development, problems of access are arising with increasing frequency, as all the more fertile lands which have easy road, rail, river or sea access are already under cultivation. The helicopter makes it possible to fly in heavy equipment over a few miles of impassable swamp or up the face of a cliff. In fact, in some instances an otherwise costly or impossible operation can be carried out quite inexpensively, easily and speedily using a helicopter.

Recently we witnessed the movement of heavy air-conditioning equipment (by *G. N. Haden & Sons Ltd.*) from ground level at Battersea Heliport up 350 ft. to the 25th floor of the new *Shell Centre* at Waterloo on the south bank of the Thames. This operation was carried out by a *British United Airways* Widgeon helicopter in five trips at a running cost of only £45 per flying hour and the whole operation was completed in just over the hour. The erection of a steel crane alone would have cost £200, road transport would have been necessary and the whole operation would have been much slower.

Sour Grapes? No!

THE PRESS CONFERENCE given by Major Yuri Gagarin on 14 April was described as a triumph of masterly evasion, his description of his epic flight was lyrical, almost to the point of musical comedy; but it was lacking in practical details. It added little to human knowledge.

During his flight he is reported to have said that 'everything was like as on earth', according to Tass, the Soviet News Agency. While descending he sang a patriotic song, and was 'full of joy' as the space ship returned to earth.

'Everything was easier to perform as my arms and legs weighed nothing'. He said that 'he sat suspended above his chair in mid-air, admiring the beauty of the earth floating in a black sky . . . ' and yet, according to Prof. Blagonravov, a Russian scientist attending the Space Symposium at Florence, there were no portholes or windows. Asked how the 'cosmonaut' could see, the professor glibly replied, 'By radio'. And how? we ask. Later he denied this, so why did he say it at all?

It was perhaps not surprising that there were many sceptics. Sir William Slater, F.R.S., former Secretary of the Agricultural Research Council of Britain, has written: 'The world's future depends not on our power to explore space, but on our ability to fill men's bellies, to give them healthy bodies, and to lift their general standard of living'. Is Russia doing this?

This is certainly a powerful argument, especially as the money that is being squandered on these accelerated programmes of space research could be put to far better use, and the concentration of scientific talent on this one field of study could be better employed in supporting, extending and actively encouraging the work of the Food and Agriculture Organisation of the United Nations than in making aggressive propaganda for a way of life.

Hazards on the Farm

THE INTRODUCTION OF MECHANICAL AIDS in farming and land reclamation operations introduces an element of danger which could be exaggerated. Actually on mechanised American farms almost a third of all the accidents are due to light agricultural equipment—hand tools and hazards such as fire. Another third are due to falls, the most severe being from ladders.

In Britain about a quarter of agricultural accidents are caused by falls; a further 15% by hand tools, 18% by light agricultural equipment, 18% burns and 10% by domesticated animals.

Figures for fatal accidents in Ceylon show over 10% of them to be due to falls—mostly falls from coconut palms—there is not much to choose from between falling from a tree and falling from a ladder.

So far as the handling of tractors and mechanised farm implements is concerned, the sarong is a tremendous handicap and tractor operators should either be provided with shorts or overalls. Another hazard all too commonly seen is exposed belting and moving machinery in coconut factories, and here, too, the sarong is a very real hazard to life and limb.

Exchange of Ideas

In a proposed exchange of ideas on agriculture, the Lord Mayor of Norwich, the Town Clerk, and the City Engineer have been invited to visit Novi Sad, Yugoslavia, in April or May.—The Times, 1 March, 1961.

Presumably, it would have been too much to have invited the County Agricultural Officer—too embarrassing, for he might have known too much.

A study in reluctant compromise. The bullock-drawn wooden plough is the traditional way; the tractor-drawn, manually-directed implement is the rather ineffective compromise

Farms before Factories?

Agriculture and Economic Growth

E. A. ATTWOOD,* M.A.

In the year 1961, the population of the world will reach three thousand million. Feeding all these people will certainly be one of the critical problems in international politics during the coming decade.

EVERY year there will be 60 million extra mouths to satisfy and, at the same time, the diets of many millions of the existing population will also have to be improved considerably if malnutrition is to be wiped out. All of this will demand a large increase in the total supply of food.

Two views

In general, there are two main reactions to this enormous problem. The pessimists, pointing to the number of people who at present are inadequately fed, maintain that only the Malthusian solution of a population 'limited by war, pestilence and disease' can be the permanent answer. The optimists, who feel that this is not inevitable, are dominated by those who advocate industrialisation as the only way out.

Both points of view give a dramatic answer to this enormous problem. Each of them can point to impressive evidence in its own support. The Malthusians have claimed—rightly—that the problem of the adequacy of the world's food supply has been of great importance since 'The Essay on the Principle of Population' was first published at the end of the 18th century, and that the *proportion* of the world population which is today underfed is probably no smaller than it was during Malthus's lifetime.

During the century and a half since then the total output of food has increased enormously, yet the number of people who are living at a bare subsistence level has risen as the benefits of modern medicine have spread across the world. In the past, unfortunately, the great need to increase food production has often led to serious erosion of the soil and to the creation of man-made deserts which will regain their capacity to produce only after many years of careful treatment.

Nevertheless, the advanced countries of Europe and North America, in spite of their dense populations, have reached a level of nutrition which is adequate; indeed, the medical problems more often arise from over-feeding than from under-feeding. The rise in the prosperity of these countries has obviously been closely linked with the industrialisation of their societies. Inevitably, therefore, those who believe that there is a reasonable possibility of raising the living standards of the poorer nations have focused their attention firmly on the opportunities which exist for large-scale industrial development. This has come to be regarded as the *only* solution to their economic problems.

The immediate need

The immediate economic need of the mass of the population of these

* Head of the Farm Management Department of the Agriculture Institute, Dublin, Eire.

These two pictures illustrate the change from a primarily subsistence type of agriculture which can never meet the needs of a nation to agriculture organised on modern lines. The main purpose is to bring a far greater area under effective cultivation, to take full advantage of rains of short duration, and so produce more and still more food

Photos: India Inf. Service

developing communities is for more food and clothes and better shelter, but it is widely held today that these can come only from an industrialised society. This, indeed, has become the orthodox economic doctrine for the development of the poorer countries of the world; industrialisation has become of greater urgency than an improved agricultural industry.

As the creation of such a society is a long-term process, the production of these basic necessities for a better living is often sacrificed so that capital goods industries can be built up. This adoption by the under-developed countries of policies which are concerned almost entirely with raising industrial output inevitably makes the immediate difficulties of the bulk of their people worse than they would otherwise be.

Temporary palliatives

These difficulties, and in particular the urgent problems of under-feeding, are lying more and more heavily on the consciences of many in the West. In the face of the desperate need of vast numbers of people in the poorer countries at a time when the richer ones are producing more than they can eat themselves there has been a growing feeling that large-scale gifts of food should be sent to bring some relief to those who are seriously underfed. But do these gifts of food really help the people to whom they are sent? If a man is hungry, obviously they help him to meet his most urgent need. Yet even where these gifts have brought some relief to a rapidly expanding population, they have only been a temporary palliative.

Unless they are combined with plans to improve the long-term food supply, they simply lead to an increase in the number of people who are living on no better than a subsistence diet. In making these gifts the Western countries have unfortunately tempted the developing countries to ignore many of the problems of improving their own agriculture. Instead, the plans of many of these countries are based on the hope that the food problem will solve itself when the industrial programme reaches an advanced stage.

False doctrine

In this way the richer nations have encouraged the approach typified by the Portuguese Minister of Economy, who said recently, in planning the development of his country, it was early recognised that 'attention should not be concentrated on agriculture, because this in itself would not be able to raise the low standard of industrialisation and thus provide an acceptable level for the national economic life'.[1]

This view would today find wide acceptance among the national planners in the under-developed countries. Unfortunately, this view of society has grown up because of the belief that agriculture is the basis of a backward economy and manufacturing industry of an advanced one, in spite of examples such as New Zealand and Denmark to the contrary.

Where large-scale economic assistance is given to these developing countries it carries with it the obligation to see that the aid provided is used to encourage the highest possible rate of economic growth. These communities need more than just a supply of goods to supplement their own national production; it is of greater importance to provide the best available knowledge for the planning of their national economies.

Three further questions

The detailed analysis of development plans is playing a more and more important part in many of the schemes of economic aid provided both by national and international organisations. When, therefore, we consider the question 'Should we give more assistance to the developing countries?' we must also ask ourselves 'Is the aid we are giving being used in the right way? Are these countries pursuing a policy which will enable them to develop as rapidly as possible, given their own resources and the amount of external aid made available to them?'

In fact, the low priority generally assigned to agriculture in their development plans is a great handicap to their rate of growth. In an attempt to shorten the time it must take them to reach economic maturity most under-developed countries have tried to reverse the pattern of economic progress which has normally been followed. This has been one involving a revolution in farming methods and the adoption of a commercialised agriculture as a preliminary to industrialisation.

Formula for success

The change from a primarily subsistence type of farming, which provides full employment for the family labour force, to one which sells the bulk of its output on the local or national market and which uses labour-saving devices to keep down costs, has proved to be a good foundation for the subsequent changes in the industrial sector. Such a change not only provides the surplus of food which the growing towns need to feed their expanding populations, but also a very considerable part of the extra labour required in the factories.

Again, the food which is exported to the towns has supplied some of the real capital needed for the creation of manufacturing industries, for in the building of new factories and plants much of the capital is used for paying labour; the worker in turn spends a high proportion of his earnings on his daily bread, and as the rural community often lend to the growing industries the money which they receive in this way, these industries can devote more of their capital to plant, machinery and buildings and less to the purchase of food for their growing labour force.

Speeding economic progress

A rapidly expanding agriculture not only makes the path of industrialisation an easier one, but it also contributes to a growing economy a great deal in its own right. Although the *rate* of potential industrial expansion in the under-developed countries is virtually unlimited (because it generally starts from practically nothing), the actual contribution made to the national economy by new industrial undertakings is very small indeed in the early years of an expansion programme. In the case of agriculture, on the other hand, the potential rate of growth in output may seem very low compared with that of manufacturing industries, but it represents a relatively large absolute increase in the total national output, because so high a proportion of that output already comes from farming.

Furthermore, improvements in farming methods offer the prospect of much greater returns to the national economy over a short period than can be earned from investments of a similar amount in industrial undertakings. As the crucial problem facing the developing countries is to reach the highest possible rate of economic growth in the early years of their plans, the opportunities for doing this by increasing farm output are especially important.

Tremendous possibilities

For example, the use of modern fertilisers has given outstanding results on land which has been cropped for centuries with very little manurial treatment of any sort. Demonstrations and experiments have shown repeatedly that very large increases in yields per acre have followed the introduction of the simplest modern farming techniques, such as using improved varieties of seed together with fertilisers which provide all the main plant nutrients.

The farming of under-developed countries is today so far behind that of the more advanced ones, that the possibilities of increasing the total output of food are enormous. Indeed, the numerous surveys which have been carried out by various international organisations have shown that they are virtually unlimited.

The change from traditional to more modern farming techniques generally involves great changes in social and economic relationships as well, but it does not usually involve a large outlay of capital.

Prof. Schultz, who is one of the world's foremost agricultural economists, has recently shown that 'much and probably most of the more recent expansion in agricultural output has come not from additional inputs of the conventional type', *i.e.* from more capital, land or labour, but 'from the improvement of the quality of the people as productive agents, and the raising of the level of the productive arts',[2] and this is true, not only for the countries with an agriculture that is already technically advanced, but also

Triumphant progress of a two-furrow tractor-drawn plough at the Indian Agricultural Research Institute at Pusa

for those who are in the early stages of economic growth.

The primary needs

As far as its demands on capital are concerned, agriculture is not a direct competitor with manufacturing industry on a very large scale. Certainly the spread of improved farming methods calls for a considerable number of trained advisers to demonstrate to the peasant farmer the value of modern techniques, and trained workers are often in short supply. Moreover, the change to a commercial agriculture will often have important consequences for the social fabric of rural life.

These problems are not, by themselves, the main factor limiting the expansion of agriculture in the developing countries. Of greater importance are some of the associated difficulties, such as that of providing an adequate network of roads or other means of getting the extra output to the growing towns. Good internal transport facilities are, of course, essential to national progress, especially in the densely populated, underdeveloped regions, and these problems have to be faced if the living standards of the whole country are to be raised. A rural community growing in prosperity, and providing the towns with an increasing supply of food and raw materials, is of very great value as a market for the products of the new industries, so that new roads and railways help both agriculture and industry.

Importance of agriculture

This is not a plea for agriculture to be given higher priority than industry, but only for it to be treated as of equal and not of subsidiary importance in the development plans of the poorer nations. Already there are welcome signs of a more realistic appreciation of its role in the early stages of economic development. In India, for example, the very small proportion of investment funds which has so far been used for increasing food output is now being increased, and in the Third Five-Year Plan agriculture has become of much greater importance in the allocation of resources in the next few years. Pilot schemes of farming improvements, covering altogether over 10 million acres, are being planned for the near future.

If we accept the thesis that agricultural improvement is essential to the economic growth of the thickly populated under-developed countries, then important conclusions will follow for ourselves and for the type of assistance that we give them. The first of these is that, *except in times of emergency, gifts of food are the wrong sort of help to send.* The crying need for more food is one which the governments concerned must face up to themselves. This is because the immediate problem of a growing food shortage will not cure itself with time, but instead is likely to become more and more acute, unless it is given the same level of priority in development plans as steelworks and other heavy industries.

Self-help and foreign aid

As the opportunities for increasing food output in these poorer countries are, for all practical purposes, unlimited, the help given will be of much greater value if it enables them to produce more food for themselves. This can be done by sending fertilisers, sprays, machinery and other aids of modern farming. In addition, and even more important, trained agriculturists are needed to demonstrate these new practices and to conduct experiments in the developing countries themselves. The lead which has been given by five American agricultural colleges in setting up sub-stations in India is one which others should follow as quickly as possible. The personal example of the staff of these stations is a concrete expression of the concern of the richer countries for the fate of the poorer.

A policy of producing more food now will bring quick relief to people who are sorely in need. The demands made by long-term plans for developing new industries have fostered the view that only by foregoing short-term opportunities can eventual success be achieved. This is far from true; on social, economic and political grounds there is a great deal to be said in favour of using all the immediate opportunities in order to raise the living standards of the poorer peoples. More food today is far more important than universal television sets tomorrow.

Final summing-up

Finally, we need to dispel the view that farming is necessarily a cause of economic backwardness and that the only route to better living standards is to direct *all* new investment into the manufacturing industries. *The advanced nations of the West have all found it desirable to give active encouragement to their agriculture; the success of their policies has been an embarrassment which the governments of the less developed countries would be only too delighted to experience.*

REFERENCES

1. Dias, J. Ferreira: 'Portugal's Six-Year Plan for Development', *Progress*, 1959.
2. Schultz, T.: 'Reflections on Agricultural Production, Output and Supply', *Journal of Farm Economics*, 1956, **38**, 3, 748-762.

Regenerating the Amazon Jungle

Trees would seem to be the principal economic asset of the Amazon valley, yet the apparently limitless supply of timber remains largely unused. Little is known about many species and the useful trees are widely dispersed and of all ages. The vast 3.5 million sq. miles of the Amazon system makes it economically difficult to bring a selected tree from stump to sawmill.

To develop this potential and start new industries the mixed forest population must be renewed with more useful species, and as a first step information on the existing species must be obtained and nurseries of the more useful ones established.

For the past five years. Mr. John Pitt, a forestry officer with FAO, has been attached to SPVEA, an organisation for the economic development of the Amazon area, to advise and assist on the application of silvicultural methods for the development and ultimate use of the Amazon forests.

He went there in 1955 to advise what improvement could be made to the standing forest and his verdict was that the present 'creaming'—that is, the removal of very valuable trees—cannot be allowed to go on much longer without some effort being made to clean up the forest and establish new plantings. Pines have now been introduced and altogether some 40 local species and 30 exotic species, including eucalyptus, are on trial for timber and pulpwood use. Work is also being done to ascertain the best way to poison weed trees, cut creepers and thin the undergrowth and tree canopy.

Photo: N. Rhodesian Inf. Dept.

Northern Rhodesia. Clearing the north bank of the Kariba Dam. Two giant £18,000 bulldozers pull these 8-ft. steel balls by means of battleship anchor chain to clear the bush. The chain cost £6,000 and the steel spheres, honeycombed inside for extra strength, cost £2,500 each. To use such expensive equipment as efficiently as possible air photographs are often used for the planning of bush clearing

Air Photography in Land Reclamation

MARTIN BRUNT*

Reclamation, or bringing land under cultivation, has a greater urgency today than ever before, because the world's population, which is continually increasing, is still dependent on finite natural resources.

THOSE who are concerned with land reclamation must use every technique available to make their work as efficient and economical as possible, as the present situation requires that land of an increasingly marginal nature must be reclaimed.

Need for maps

The need of land reclaimers and developers for maps is now well appreciated and this was partly responsible for the formation in 1946 of the Directorate of Overseas Surveys. This U.K.-based organisation uses air photographs in the course of preparing topographic maps of overseas territories. This article does not describe mapping from air photographs, however, but rather some of the special applications that the air photograph has to reclamation problems.

The general features that recommend the air photograph to the land reclaimer must first be noted. It presents an overall picture of ground conditions on which topographic details, going conditions for vehicles, nature of vegetative cover and other details may be clearly seen. The air photograph can be used directly as a field document; mounted together as a mosaic or print laydown to form a 'photographic map'; or converted quickly into a rough sketch map. This sketch will not have the accuracy or sophistication of proper topographic maps, but the speed with which it can be produced makes it particularly useful. It can also be converted into an accurate map, but this takes longer and requires additional ground survey control.

Air photographs, of course, may not exist of the area to be reclaimed, or producing them in the tropics may be difficult because of weather conditions, and the scheme being considered may be too small to justify the expenditure.

However, a good part of the tropics has been aerially photographed for general mapping purposes, and more is being covered each year, so that the chances are increasing that some air photograph cover exists, particularly in British overseas territories. It is in the tropical areas that the largest tracts of unclaimed land still remain.

For convenience, we will divide reclamation problems into three groups—those concerned with: 1. Virgin land. 2. Denuded and degraded land. 3. Land under use, but inefficiently organised. These will be considered systematically.

VIRGIN LAND

When considering the development of virgin lands the environment should be fully considered before pilot schemes are started. The two most important factors—availability of water and fertility of soil—may be appreciated by studying the natural vegetation, as this so often reflects the result of the

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Photos: Kenya Inf. Services

Before Land Consolidation, Kenya **After Land Consolidation, Kenya**

Left: *Kikuyu farming area before consolidation, showing haphazard patchwork cultivation, virtually no soil conservation measures and much uncultivated land.* Right: *Using maps prepared from aerial photographs, the land consolidation exercise has been completed. The haphazard patchwork cultivation has gone, land use is rationally arranged and full soil conservation measures have been established. The land has been fully reclaimed*

interaction between the two factors.

Vegetation differences often show clearly on air photographs, and these can be used in mapping large areas quickly at a reconnaissance level. The would-be developer will also be able to assess the problem of communications using the air photographs, the siting of new roads, the amount of cut and fill required in their construction and other fundamental problems which will occur.

The air photograph will not, of course, provide the detailed information required before reclamation operations can be started; this must nearly always be obtained from detailed ground investigations, usually followed by field experiments.

There are many examples of this kind of work. One of the first surveys of agricultural interest using air photographs was undertaken in 1924, when part of the mangrove swamps of the Irrawaddy Delta in Burma were surveyed.[1] More recently mangrove swamps in West Africa have been extensively mapped by the Directorate of Overseas Surveys for the Sierra Leone and Gambia Departments of Agriculture. The scales have ranged from 1/16-1/40,000.[2]

Photo: Kenya Inf. Services

Land Consolidation, Kenya

In spite of the extensive use of air photography, some ground survey work is ultimately inevitable during land consolidation and farm planning. A member of a land consolidation team is seen using a plane table in the course of this work

Ecological indications

West African *Rhizophora* mangrove usually occurs on organic-rich, salt-free soils, while *Avicennia* mangrove is usually found on organic-free, salt-rich soils. If these mangrove swamps are reclaimed for rice cultivation, then different husbandry practices must obviously be followed. Swamp rice must be grown on *Rhizophora* soils, because any system which allows the soil to dry accelerates the oxidation of the organic matter with consequent acid formation in the soil, obviously with serious results.

Conversely, in order to remove the salt from the *Avicennia* soils, the land must be empoldered to exclude brackish tidal water, while fresh or rain water is being used to wash the soil clean enough to grow rice.

Rhizophora can be distinguished from *Avicennia* mangrove on air photographs, the value of which hardly needs further description. This will be enormously appreciated by anyone who has had to survey mangrove swamps on the ground.

Operations in Australia

In Australia the Land Research and Regional Survey Section of the

C.S.I.R.O. has undertaken extensive reconnaissance surveys of thousands of square miles of the under-developed areas, particularly in the Northern Territory.[3] In each case the approach has been a logical one.

Initially a broad appraisal of the area has been made. The geology, geomorphology, hydrology, soils and vegetation have been surveyed and their relationships assessed. The dynamic erosional aspect of the environment is next considered, and finally this large volume of information is related to land use problems. Following this appraisal, proposals are drawn up for field experimentation on which serious recommendations for reclamation and development can be based. In this comprehensive programme the air photograph is extensively used.

Photo: C.O.I. Crown Copyright Reserved

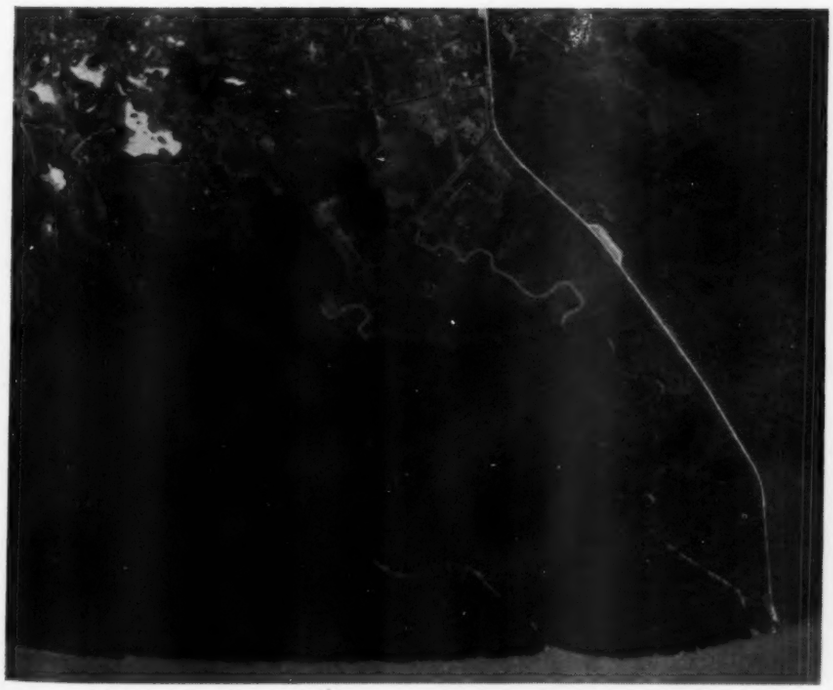
Root System of Mangrove Swamp in Gambia, West Africa

Difficult to clear and difficult to survey such areas on the ground. Survey is only really practicable using air photographs. Mangrove swamp makes good rice land and has been extensively reclaimed in West Africa for this purpose

Bush density and tsetse

The use of the air photograph in order to select virgin land suitable for grazing is another example of this technique. In this case the problem often has two aspects: (*a*) To select a disease-free area. (*b*) To keep down the cost of scrub clearing.

While the distribution of most cattle diseases can only be studied on the ground, the distribution of one of the major diseases which may occur in the tropical under-developed areas—trypanosomiasis—can be determined from air photographs, for there is a correlation between bush density and the incidence of the tsetse fly, which is the vector of this disease. Knowing that trypanosomiasis† may occur in an area being considered for clearing, and knowing the critical bush densities, the air photograph is obviously a very valuable tool for the selection of areas that can be reclaimed for grazing.



Mangrove Swamp from 10,000 ft., Gambia, West Africa

Tall Rhizophora *mangrove shows dark-toned bordering the river. Short* Avicennia *mangrove shows light-toned on the landward side of the* Rhizophora. *Each species usually indicates different soil characteristics and, if cleared, different husbandry practices must be followed if rice is to be grown. Rice fields border the road*

This technique was used in connection with the Lambwe Valley Settlement Scheme in Kenya, where a bush density-ecological map was made from air photographs. Not only was this used for planning the layout of the scheme and for assessing clearance costs, but also for the best location of bush-free belts to serve as fly barriers to control the movement of the tsetse fly.

Even if trypanosomiasis is not a problem, it is obviously desirable to locate grazing schemes, or indeed any scheme, so that as little clearing as possible is required. Thus the Kenya Veterinary Department have used air photographs to help select prospective grazing areas to include as much open vlei grassland as possible.

The value of this rational planning

† Sleeping sickness in man and animals.

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Mangrove Swamp at Ground Level, Gambia, West Africa

Tall Rhizophora *mangrove can be seen behind a fringe of shorter* Avicennia *mangrove. In the foreground local farmers are co-operating to build a causeway to facilitate access to the rice fields during the wet season on land recently reclaimed from swamp*

of clearing operations will be appreciated from the following figures of the capital sums involved in such work, quite apart from the operating costs. Bush clearance on the northern bank of the Kariba Dam in Northern Rhodesia was recently done by bulldozers operating in pairs and towing a very heavy chain with three 8-ft. steel balls attached. The bulldozers cost £18,000 each, the balls £2,500 each and the chain £6,000.

Further factors affecting clearing costs are not only the size of the trees to be felled and moved, but also the presence or absence of termite mounds. Such mounds are found extensively in the savannah areas of the world and can be assessed with some accuracy from the air photograph.

ERODED AND DEGRADED LAND

Land reclamation to most people means reclaiming degraded land, possibly because of the vast success of the Tennessee Valley Authority in this connection. The first problem before the practical reclamation can begin is to determine the extent of the eroded and degraded land. The scars of gully erosion and the denuded aspect of sheet eroded land show up well on air photographs. The damaged area must then be related to its catchment.

If reclamation work, particularly of an anti-erosional kind, is undertaken on a purely local basis, the prevention of erosion in part of a catchment may simply serve to accelerate it elsewhere. The dynamics of the hydrology of the whole catchment must be considered. Maps may be available, but they can usually be usefully supplemented by reference to any available air photograph cover, which, of course, will show much more minor detail.

At this stage the area of the catchment will be determined in relation to stream flow and run-off assessment. This will provide fundamental information to help with dam designing, proposing culvert sizes, the areas of grassed waterways and so on.

From this stage it is possible to proceed to planning the field work. Much time can be saved by preliminary work in the office: the siting of dams, contour drains, bunds and terraces; the areas best put under permanent tree cover and other proposals can be planned during the stereoscopic examination of the air photograph in the office. The field work is then carried out on conventional lines.

Anti-erosion operations

A good example comes from the West Indian island of Grenada. In 1956, hurricane 'Janet' caused over £3½ million worth of damage, a very serious matter for an island only 133 sq. miles in extent and almost entirely dependent on agriculture. U.K. aid was granted and an Agricultural Rehabilitation Committee was set up under the chairmanship of the late Director of Agriculture from Jamaica. He very properly called for a soil and land capability survey as the basis for rehabilitation.

This was carried out, using air photographs of 1/18,000 scale as the basis for all the recording. Maps of 1/25,000 scale, made by the Directorate of Overseas Surveys, were available, but in a small island of great topographic complexity some generalisations of topographic detail were bound to occur on the map; thus the photographs were invaluable. Not only were land reclamation and soil conservation measures based on this survey, but so also were questions of farm planning, rights to grants and subsidies for development and other aspects of the rehabilitation work.

The importance and value of this work is further reflected in the fact that several private air survey companies have been able to offer specialist technical survey services for agricultural and forestry development attached to the air survey organisations. A piece of work by one of these companies (Hunting Technical Services) in connection with land reclamation for irrigation has been described by Gillman.[3]

FAULTY LAND USE

This description would fit much of the tropical agricultural production which is still being carried on by peasant farmers whose production methods are often very primitive. This may be due to the system of land tenure and fragmentation of holdings, to the cultivation of the wrong crops, to faulty husbandry methods and so on. The air photograph has been used as an aid in correcting this situation.

Reorganisation of land holdings

Probably the best example comes from Kenya. The land consolidation exercise in the Kikuyu farming area is well known. Here farming was adversely affected by seriously fragmented holdings: some families cultivated as many as 15-20 plots of land within a radius of 5-10 miles, and obviously spent much time getting from one to another in order to work them. Litigation over farm boundaries had almost become a major pastime.

The increased powers granted to government under the emergency regulations allowed the complete reorganisation of these holdings. The resulting reclamation involved a considerable amount of surveying. In the first instance, much of this was carried

(*Continued on page* 182)

Land Won from the Sea

1—The Problems and How They Were Met

SIR E. JOHN RUSSELL,* F.R.S.

The reclamation of the Zuyder Zee was first proposed in 1912, *but it was not until* 1927 *that work commenced. Our distinguished contributor has followed their development with the keenest interest and has visited the area on several occasions.*

IT had long been known in Holland that the great stretch of water known as the Zuyder Zee, sticking into the country like an inflated sack, had once been dry land which, however, had slowly sunk until finally it became submerged. Much of Holland is now so low that, but for the dykes, it would be flooded at high tide. In no other country has so much experience been gained in protecting land against the sea and in winning back low-lying land.

For years it had been felt that the Zuyder Zee could be reclaimed and in 1891 the famous engineer, Cornelius Lely, put forward his well-considered plan; a start was proposed for 1912, but it was held up by the 1914-18 war. When this ended, the detailed studies were begun.

A soil survey of the floor of the sea was made, enabling a soil utilisation map to be prepared showing the best positions for the dykes and the villages and the types of farming most appropriate for the different new districts. The survey showed, however, that even after the water had been removed the sea floor could not at once be cultivated: during its long submergence the clay constituent of the soil had changed its character through the displacement of calcium by sodium, also considerable amounts of sea salts remained in the soil which would seriously injure the crops.

The great sea wall

When finally in 1927 the work of construction commenced it involved three major operations. One was to make the great enclosing dam to shut out the North Sea. This started from Den Dever at the eastern tip of the island of Wieringen and stretched in a north-easterly direction across to Friesland.

Fig. 1. *Drainage first operation. A trencher plough cuts open trenches* 2 *ft. deep into which the water drains and then flows into the main ditches. A few years later the trench is deepened to about* 3½ *ft. and drain pipes are laid*

This dyke is a colossal affair, nearly 20 miles long; it is 145 yd. wide at its base and 100 yd. wide at sea level; it carries a motor road nearly 20 yd. wide, a strip for a double-track railway and ample grass verges; it has 25 sluices to let water out from the land side at low tide and three locks to allow small vessels to enter. It is about 24 ft. above mean sea level and nearly 12 ft. above the highest recorded flood level. It took five years to construct, but so well was it done that never yet in all the ensuing 28 years has there been any breach or invasion by the sea.

The Yssel fresh-water lake

There was no intention of draining all the 870,000 acres of the Zuyder Zee on the landward side of this dyke. Holland has abundance of salt water, which is useless for most practical purposes, but there is a dearth of fresh water for irrigation, industrial and domestic purposes. Some 300,000 acres of the enclosed area was to remain as Lake Yssel, its water gradually losing its salt as rivers flowed into it and then passed out through the sluices at low tide.

Of the remaining area, 550,000 acres were to be endyked in five polders.† Being inside the great enclosing dyke they would be safe from the North Sea storms and floods, so that their dykes could be lower and less costly; they

* Director of Rothamsted Experimental Station, 1912-43.

† Polder: a piece of low-lying land reclaimed from the sea, a lake or river, from which it is protected by dykes.

must still, however, be massive structures, as the land surface was some 12 ft. below the surface of the lake, which itself was below the mean level of the outside sea.

The Wieringermeer polder

The first of these polders to be made was the Wieringermeer, a large bay on the south side of Wieringen island. The work began in 1927; by 1930 the dyke was complete and pumping began. As the water level fell the fish collected in the deeper places and the fishermen simply scooped them out. For a time the whole district reeked of fish.

Where the water had been shallow, land was already emerging and we took samples with the auger: there were 20 in. of sand and below there was a layer of peat resting on clay containing many plant residues; this had been the old land surface, apparently a sphagnum bog submerged by an eruption of the North Sea about 1,000 years ago and gradually covered up with sand.

Fig. 2. Ploughing 6 ft. deep to bring up good clay for mixing with the surface sand, using a powerful implement drawn by three tractors

Andijk experimental polder

The third operation in the 1927 programme, and a distinctive feature of the whole enterprise, was the setting up of an experimental polder of 100 acres near Andijk in North Holland to investigate the problems that farmers would meet when the polders were ready for cultivation—particularly how to bring the soil into good condition, what crops to grow and how to grow them. This work, which was under the direction of the well-known soil scientist, Dr. D. J. Hissink, I first saw in 1930.

A proper drainage system proved to be the key to soil conditioning. Little improvement could be effected while salt remained in the soil, but with effective drainage the rain washed it out and then the calcium carbonate in the soil reacted with the unkindly sodium clay, producing the calcium clay to which our varieties and methods are suited. Depths and distances apart of the drains were estimated from permeability studies and checked by trial. Soil analysis checked by field trials showed the fertiliser requirements of crops, and a large number of variety trials showed which were the best to grow.

I was back again in 1932. In the interval there had been dramatic changes. After six months of pumping, during which about 130 thousand million gal. of water had been lifted out, the whole Wieringermeer polder was dry; there were roads and houses and the beginnings of a town; experimental plots were established and much operational work was being done on drainage.

Land drainage machines

Some remarkable machines were being tested, including one that made drainage tubes out of steel bands and laid them as it went along; another made and laid rectangular wooden pipes; others used the conventional clay pipes. Depths and distances apart had been duly ascertained by permeability studies and checked by trial. During the early stages the drains were open—no less than 8,750 miles of them had been dug, mostly by hand, but towards the end and in all later reclamations this was done by machine (Fig. 1).

About a year sufficed for the rain to wash the salt out of the sandy soils, but two or three years were needed for the clays; it went into the main drain, from where it was pumped into the lake. The rainfall is about 28 in. a year, but only about 8 in. can percolate so long as the clay retains its original waterlogged and swollen condition; the rest evaporates in the high winds. After some years the clay becomes drier and percolation is then easier; at this stage the drains are deepened and pipes laid.

Planned settlement

The land was then set out in rows of 50-acre rectangular blocks with a metalled road along one side and a wide ditch on the other. In the early stages this ditch was often made navigable, but later on transport improved and this became unnecessary. Then cultivation began. At first, while the land was being got into 'proper heart', this was done by the Government. Large farms of 750-1,250 acres were set up, each under an official agronomist.

Winter wheat undersown with clover was usually the first crop; inoculation was necessary, as initially the necessary nodule organisms were lacking. Leguminous crops were very beneficial, as the soil was deficient in nitrogenous organic matter; it also lacked phosphate. The soils are very varied—vertically as well as horizontally; more than 5,000 acres of the sands were ploughed 6 ft. deep—in some cases deeper—to bring up clay to mingle with the surface sandy layers (Fig. 2).

Meanwhile three villages and a central town were being built on a coherent plan and in attractive style,

Left: *Fig. 3. Middermeer, a small town on the Wieringermeer Polder, in 1950; 20 years earlier this had been open sea.* Right: *Fig. 4. One of the farmhouses in the settlement. The farms are small by British standards: 60 acres is a common size*

each with a wooded park for recreation: one of these model villages later developed into a small town (Fig. 3). The farms were getting into shape, trees were planted along the roads and shrubs around the farm buildings (Fig. 4).

Then came tragedy. The Second World War was on and in April 1945, just before the end, the Germans, before quitting the country, blew up the protecting dyke and submerged the whole polder, doing appalling damage. Nevertheless, as soon as they had gone the Netherlanders with superb courage set about the restoration, but eight years had to pass before it was complete.

By 1955 some 520 farms had been set up, varying in size from 25-200 acres. Out of a total area of 49,000 acres, no less than 45,000 are now arable, 37% being in cereals, nearly 50% in potatoes, sugar-beet, peas and beans and fibrous flax (exported to Belgium to be worked up) in roughly equal proportions. The population of the polder is now about 8,000 and the annual value of its farm produce is some £3-4 million.

The north-eastern polder

Work was begun on the North-eastern Polder in 1936. This is nearly 120,000 acres in extent, two and a half times the size of the Wieringermeer polder, and all operations had correspondingly to be enlarged. Forty miles of dyke had to be made; this took four years and the pumping out of the water took another two. It was now 1942 and the war was at its height; little progress was possible till 1947. On the east side the polder joins the mainland; it shelves to the west and at its deepest is about 16 ft. below mean sea level; the ground water level is kept $2\frac{3}{4}$ ft. lower still.

One million gal. per min.

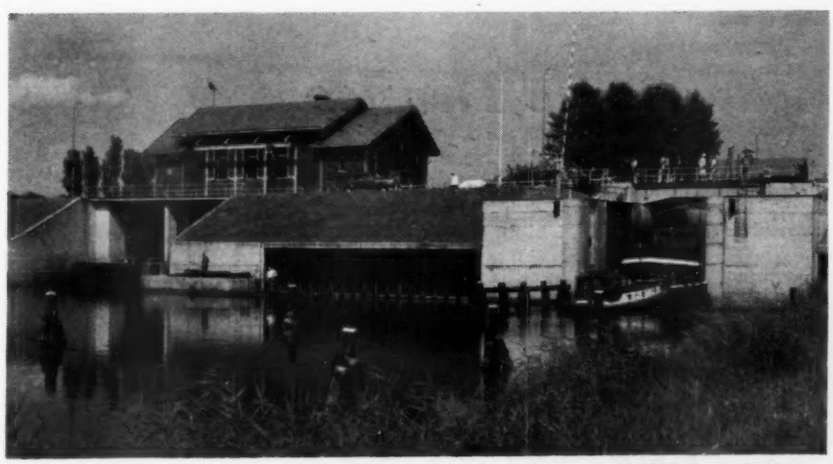
A powerful pumping system is therefore necessary: it comprises three stations with a total of eight centrifugal pumps, six having each a capacity of 120,000 gal. per min. and two larger rotary pumps, each with a capacity of more than 130,000 gal. per min.—an aggregate pumping capacity of about 1 million gal. per minute (Fig. 5).

I visited this polder in August 1950. Drainage had recently been completed: it was much more highly mechanised than the earlier operations. Some 20,500 miles of trenches had been dug and the pipes laid entirely by machine, clay pipes being used. A modification in the method of laying these pipes on sandy and peaty soils had also been introduced.

These soils are liable to dry out, and as the water of Yssel Lake now contained very little salt it could safely be used for irrigation. When needed it is allowed to enter the polder through inlet gates in the dyke and directed to the ditches skirting the land to be irrigated; it then enters the drains, which had been laid horizontally, and so raises the ground water level. Two-thirds of this sub-irrigated land is to be in grass, mostly for carrying dairy cattle.

Experimental farms

An experimental farm of 125 acres



Photos: Royal Netherlands Embassy

Fig. 5. North-Eastern Polder. The Smeenge pumping station with two electrically-driven rotary pumps having a total capacity of more than 260,000 gal. per min.

with 50 outside centres was already providing valuable information for the future farmers. Large-scale settlement had begun, but was not yet advanced. The land was still being farmed by the Government agronomists in units of 900-1,250 acres. Ten villages were already under construction and they were so placed that no farm was more than a mile away from one. I visited one of them, Kraggenburg, named after a lighthouse that formerly stood on the site. Its attractive little houses were already occupied and their gardens with true Dutch thoroughness were being put into shape. Ornamental shrubs were given by the Government and competent experts gave free advice. A shop was functioning and also a school, beautifully light and airy; as yet there was no church, but the people held services in each other's houses.

I also went to Emmeloord, named after an islet and fisher hamlet that had to be abandoned in 1859 because of the encroachments of the sea. Much sand dredged from the canals had been used for levelling and some fine buildings were going up. Everywhere development was proceeding vigorously, the large labour force being housed in camps. All was done on sound sociological lines using good architectural design: there was no shack stage; everything put up for habitation had to be good enough to stay up. That indeed, is characteristic of the whole enterprise.

(*To be continued*)

Air Photography in Land Reclamation

(*Continued from page* 178)

out by the simplest techniques: the initial measuring of fragments, the later redistribution of land, and the fixing of consolidated farm boundaries largely by means of the chain and compass.

Inevitably errors crept in and the survey results were not sufficiently good to qualify for the very high standards required by cadastral‡ survey for titles to land. The obvious solution was to use air survey techniques. The Survey of Kenya bought sufficient equipment with Swynnerton Plan funds to tackle the survey of the work by using air photography entirely.

Land re-settlement operations

The system now used is as follows: The area to be consolidated is photographed at 1/25,000 scale. Large scale maps are made from this photography which comply with cadastral standards of accuracy. The fragmented holdings are measured in the field by chaining. This, of course, is done in conjunction with the land owners concerned, as is the redistribution of the farm lands.

The total acreage of the holdings of the farmers concerned is then determined and a small percentage (usually 5%) is deducted for public use (school sites, market places and so on). The position of new farm boundaries are agreed and these are marked on the maps at the same time as they are pegged on the ground. The farmer is required to plant hedging along the boundary. On this basis a provisional title is issued.

‡ Taxable land.

Because of the size of this exercise and the speed with which it had to be carried out, and because of the shortage of highly trained staff, the position of the consolidated farm boundary as shown on the map would not necessarily comply with cadastral standards. So the areas are re-photographed after two years, by which time the hedges will have grown sufficiently to show clearly on the new air photographs. The position of these hedges are then compared to the original boundary plottings and if any adjustments are required they are made. This then provides the survey basis for permanent title to the land holdings.

Given the security that this title provides, the transformation from subsistence to cash farming can be achieved—reclamation, in fact, in the biggest sense of the word.[5]

REFERENCES

1. Kemp, R. C., Scott, R. W., Lewis, C. G., and Robbins, C. R.: 'Aero-photo Survey and Mapping of the Forests of the Irrawaddy Delta, Burma', *For Bull.*, 1925, No. 11.
2. Brunt, M.: 'The Gambia Land Use and Vegetation Survey', Third Inter-African Soils Conference (C.C.T.A./C.S.A.), Dalaba, 1959.
3. Christian, C. S., Stewart, G. A., and Noakes, L. C.: Survey of: 1. Katherine-Darwin Region (1946). 2. Tounsville-Bowen Region (1950). 3. Barkly Region (1947-48). Land Research Series, Nos. 1, 2 and 3, C.S.I.R.O., Melbourne, 1952, 1953 and 1954.
4. Gillman, H.: 'Land Classification for Irrigation Development in Iraq', *World Crops*, 1958, **10**, 129.
5. Kolbe, L. H., and Fouche, S. J.: 'Land Consolidation and Farm Planning in the Central Province', Government Printer, Nairobi, Kenya, 1959.

Sound Development Plans in Malaya

The Federation of Malaya's Second Five-Year Plan, recently announced by Tun Abdul Razak, requires an investment of $5,050 million—$2,150 million by the Government and public enterprise and $2,900 million by private sources.

The Deputy Prime Minister described the plan now being launched as a bold programme for accelerating the economic growth of this young nation.

About 50% of the proposed investment will be for rural development, with priority accorded to agricultural and land development, rural roads, water supplies and other amenities.

In agriculture the aim was to raise the level of investment on irrigation, increase production of rice and other crops, develop the oil palm industry, forestry, fisheries and animal husbandry and rehabilitate certain coconut areas. About $191 million has been allocated for land development and another 75,000-80,000 acres of new land would be opened up under the group settlement programme.

Stressing the significance of the Second Five-Year Plan, Tun Abdul Razak said that there should be no illusions about the basic problems of Malaya's economy today. 'Our rate of population growth, at about 3.3% a year, is one of the highest in the world, and in the next five years jobs have to be found for about 340,000 workers entering the labour market, while the number of children of primary school age will increase by about 200,000'.

£1 sterling = M$8.50. M$5,000 million = £600 million

Deficiency Diseases of Crops in Holland

J. J. LEHR*

HOLLAND is an example of a country in which soil fertility differs greatly from district to district. The coastal provinces, where the soils are chiefly marine clays, sometimes interrupted by areas of peaty clay, have long been recognised as very fertile. The sandy soils found further inland are poorer because of their low content of plant nutrient elements and their frequently acid reaction. Between these two extremes lie the river clays and peaty clays, which are more similar to the marine clays in fertility. The loams, which are fairly rare, are, on the contrary, more similar to the sandy soils in their productive capacity.

The marine clays are chiefly distinguished by their richness in calcium, potassium, sodium and magnesium and in the trace elements, boron and iodine. They are fairly well provided with the other trace elements except for manganese, which is not an uncommon deficiency. The manganese content of the river clays is generally higher than that of the marine clays, but, nevertheless, manganese deficiency is sometimes observed even in the river clays. The differences in fertility and richness between the coastal districts and the poor sandy inland districts are not obvious because of the intensive use of chemical fertilisers.

However, their intensive use on sandy soils increases the chance of deficiency in trace elements because the application of the major elements alone can accentuate the general poverty of the soil. Deficiencies of magnesium, boron, manganese and copper are found in crops, and of cobalt and iodine in animals.

Sand drown disease of tobacco due to magnesium deficiency. The leaf gradually turns yellow, remaining green along the veins until the entire leaf loses its normal colour

The relative richness of Dutch soils in magnesium and certain trace elements is shown in Table 1, which gives their mean contents of these elements. The figures for magnesium and boron were determined from more abundant material than were those for iodine, iron, manganese and cobalt, but, nevertheless, the table indicates the characteristic differences in the fertility of the various soils.

Table 1

Contents of Magnesium and Trace Elements in Dutch Soils

Type of soil	*MgO* 0.5 *N* acetic acid	*B* hot water	*I* HCl	*Fe* total	*Mn* total	*Co* 2½% acetic acid
	p.p.m.	*p.p.m.*	*p.p.m.*	%	%	*p.p.m.*
Marine clay ..	406	2.0	4.0	1.15	0.02	1.0
Peaty clay ..	375‡	—	2.3	2.3	0.04	2.8
River clay ..	344	0.8	0.91	1.7	0.07	2.0§
River loam ..	—	0.42	—	—	—	0.8
Loam	32	0.46	—	—	—	2.0
Northern sands..	68	0.47	0.76§	0.4§	0.005§	0.5
Eastern sands ..	38	0.42	—	—	—	0.3
Southern sands..	29	0.41	0.47§	0.3§	0.005§	0.5
Peaty sands ..	200‡	—	—	—	—	1.0

‡ Extraction with 0.5 *N* acetic acid + 0.75 *N* sodium acetate.
§ Doubtful or based on insufficient material.

Table 2

Copper Content of a Sandy Soil at Achterhoek, Eastern Holland
(200 *samples*)

Copper content *p.p.m.*	*Arable land* %	*Grassland* %
Less than 2 ..	39	51
2-5	49	38
6 or more ..	12	11

The copper contents of an arable soil and those of a grassland soil are given in Table 2. From 2-5 p.p.m. is regarded as sufficient for the former, but this is low for grassland. Moreover, in the peaty-clay pasture districts of Western Holland copper deficiency in animals is found despite the fact that the soil and the grasses contain sufficient copper. In this case there are certainly other causes which interfere with copper assimilation.

With other trace elements, however, there is a direct relationship between their content in the different soils and the distribution of deficiency diseases. It has been observed that heart rot

*Plant Nutrition Research Laboratory, Chilean Nitrate Agricultural Service, Wageningen, Holland.

in sugar-beet is infrequent on the marine clays. It is somewhat more common on the river clays, fairly frequent on loams and very frequent on sandy soils, especially in dry years.

A similar relationship exists with magnesium. Indeed, magnesium deficiency is often found on sandy and loamy soils, but hardly ever on river clays and marine clays.

Deficiency diseases in crops

Magnesium

Hooghalen disease, which is characterised by an uneven distribution of the chlorophyll and a yellowish colour, is frequently found in wheat and is common on humic or peaty sands. It is due not to poverty in magnesium alone, but also either to the acid reaction of the soil, or to an excess of potassium, or to these two factors in association. Liming or fertilising with Chilean nitrate is often sufficient to cure the disease.

At the present time actual deficiency of magnesium is to be found in potato, beet, maize, turnip and other field crops. It is more frequent in arboriculture and in some market garden plants, especially tomato. On acid soils the disease can be controlled by magnesian limestone amendments. For slightly acid or neutral soils kieserite or kainite, which contain magnesium, are recommended.

Boron

In Dutch agriculture boron deficiency is limited almost entirely to heart rot in beet and brown heart in turnip. It is occasionally found in cauliflower and chicory, and it produces internal cork in apples.

It has been shown in the field that boron deficiency is aggravated by overliming and is commoner on ploughed grassland and after beet than after other crops. Dry years favour the disease. For control the use of borax is recommended.†

Manganese

Manganese deficiency in wheat (grey speck) was formerly common on overlimed humic and peaty sands, but nowadays it is rare. However, deficiencies are observed in beet, pea and other crops, especially in the marine clay districts. Chlorotic symptoms due to manganese deficiency are found fairly often in arboriculture and market gardening, but the disease does not cause much damage. Applications of manganese sulphate with the fertiliser result in improved growth, but the manganese quickly becomes inactive. It follows that fairly large quantities—

Pot trials with oats: without manganese (left) *and with manganese* (right)

50 kg. per ha.—must be applied in several dressings.

Copper

Copper deficiency has been observed in Holland and the neighbouring countries (Germany and Denmark) on newly ploughed land, especially in wheat (reclamation disease). Other crops susceptible to copper deficiency are pea, bean and lupin; the disease is difficult to recognise in these crops because the plants appear to develop normally, but later it is found that they produce scarcely any seed. Copper-containing slag, compost or copper sulphate are used for the control of the disease. In arboriculture copper deficiency is found in apple, pear and plum (die-back of young shoots and formation of new shoots) on very poor sands and sometimes also on marine clays.

Zinc

Zinc deficiency has not yet been detected in field and market garden crops in Holland, but it occurs in arboriculture (apple, pear, cherry, plum), especially on soils rich in phosphate. It is controlled by spraying with 5% zinc sulphate before bud burst or with 1% zinc sulphate and 0.5% lime after blossoming.

Molybdenum

Cauliflower is the only crop in which molybdenum deficiency is known for certain to exist in Holland. Acid soils deficient in molybdenum should be limed. Diseased plants should be sprayed with a 0.1% solution of ammonium molybdate.

Iron

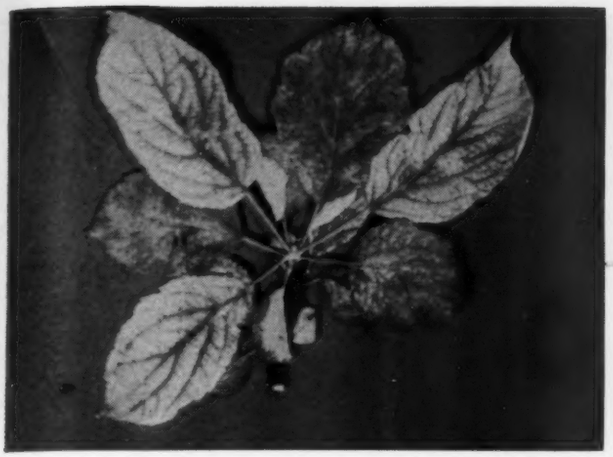
Iron deficiency has not yet been observed in field crops in Holland. In arboriculture, in bulb growing and in floriculture, however, it is frequently seen, especially on lime-rich soils, as chlorosis of the young leaves. It can be controlled by spraying with ferrous sulphate or ferrous citrate and, nowadays, with organic compounds of iron, the sequestrene products, which should be applied as 0.1% sprays.

Table 3

Estimated Annual Consumption of Trace Element Fertilisers in Holland

Fertilisers	*In fertiliser Tons*	*In mineral mixtures Tons*	*Quantity of copper in the fertiliser Tons*
Copper sulphate	100	100	25
Copper slag	8,000		130
Town refuse	145,000		58
Nightsoil	82,000		
Borax	400		
Manganese sulphate	150	100	
Cobalt sulphate		10-20	
Sporumix	100		

† Chilean nitrate of soda and Chilean potash nitrate are basic in reaction and their use tends to reduce acidity and to promote the availability of magnesium, molybdenum, zinc and copper. Chilean nitrate of soda contains about 0.05% boron and with normal applications is usually sufficient to prevent the appearance of boron deficiency symptoms; it brings no risk of boron toxicity.



Left: *Cluster of apple leaves showing intervenal chlorosis typical of iron deficiency. The terminal leaves are the first to be affected*

Right: *Ears of barley affected by reclamation disease or yellow tip. The affected plants show a tendency to wilt, while the younger leaves have shrivelled tips and may fail to unroll. The heads are distorted and yield is greatly reduced*

Correction of deficiencies

As there are no statistics regarding the consumption of trace elements, an estimate is given in Table 3 of the total quantities used in Dutch agriculture each year.

In comparison with the recent annual consumption of nitrogen, phosphate and potash, *viz.* 175,000 tons N, 120,000 tons P_2O_5 and 150,000 tons K_2O, and allowing for the different rates of application of macro- and micro-nutrients, these quantities are rather low. The highest are those for copper, of which, according to this estimate, there is an annual consumption of about 215 tons. This quantity would be sufficient for the fertilisation of only about 64,000 ha. Even if copper dressings are regarded as having a residual effect for three years, it seems that only a small fraction of the total farmed area of Holland ($2\frac{1}{2}$ million ha. of arable land and grassland, of which half is on poor soil) receives regular copper fertilisation. In practice copper is chiefly applied to newly reclaimed land and grassland, including grassland on soils which are not particularly poor in copper.

The use of zinc sulphate is probably confined to very small quantities in arboriculture. The situation with regard to magnesium is no better. The amount applied annually in calcareous amendments — magnesian kainite, kieserite and slag—can be estimated at about 25,000 tons of magnesia (MgO), although the annual needs of Holland are calculated to be 50,000 tons MgO.

From the above outline of the position it is evident that the supply of magnesium and trace elements for Dutch agriculture is open to improvement. Of course, it must not be forgotten that in practice the adequate provision of trace elements does not depend solely on the use of fertilisers containing them.

Maintenance applications

Without wishing to lose sight of the danger of toxicity from excessive application, the writer considers that, on the sandy soils which constitute 50% of the cultivated area of Holland, the danger of trace element deficiencies is greater than that of injury from excess. *The conditions which particularly favour deficiencies are the intensive use of NPK fertilisers together with intensive use of the soil and too few green manure crops, and also the use of relatively small quantities of farmyard manure and the application of concentrated and purified types of fertilisers.*

With regard to the steps to be taken, it is necessary to differentiate between measures of improvement and those of maintenance. The first are necessary where distinct symptoms of deficiency are observed. The second are taken primarily to increase the certainty of good harvests. Even if very distinct symptoms of diseases are not seen, it must always be taken into consideration *that harvests can be reduced as a result of trace element deficiencies which exist but are not evident, and that produce may not have the desired nutritive quality.*

To arrive at an effective dressing of magnesium and trace elements in practice the type of soil and the requirements of the crop must be taken into consideration. Moreover, there must be a balanced relationship between major and trace elements.

This is a WORLD CROPS Digest of a paper communicated to the Fifth International Congress of Chemical Fertilisers, held in Belgrade in 1956.

Water for Pyrethrum

Investigations in Kenya by Dr. U. Kroll,* have shown that variations in mean temperature and in rainfall can materially affect the pyrethrins content of pyrethrum flowers. The pyrethrins content has been found to increase with the rainfall and reach a peak percentage with 4 in. of rain per month.

These findings are supported by work carried out at the Pyrethrum Experimental Farm in Colorado, U.S.A., where 5 acres out of 50 acres of pyrethrum were watered by sprinklers. The watered section gave a pyrethrins content of 1.3%, as against only 0.9% in the flowers in the other 45 acres.

As a result of the work done in Kenya to develop strains suited to particular growing areas the average pyrethrins content of flowers delivered to the Pyrethrum Board of Kenya is now 1.55%.

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* Senior Pyrethrum Officer, Ministry of Agriculture, Kenya

Rotating boom-type sprinkler irrigating a seeded pasture. The overall length of the sprinkler arms is 250 ft. and the height of the tower is 17 ft. 6 in. There are eight nozzles and the maximum discharge of the sprinkler when fitted with 1-in. nozzles is 895 gal. per min. at 80 lb. per sq. in. The unit will cover 4 acres per setting

Sprinkler Irrigation in the U.S.A.—2*

C. H. PAIR†

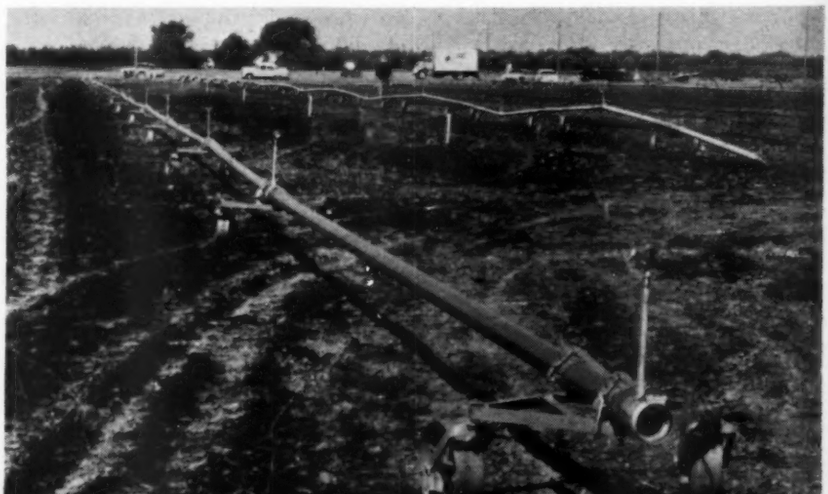
Concluding his description of the sprinklers used in the U.S.A., the author here describes more elaborate sprinkler systems now on large-scale trial.

Pull-type systems

Another mechanised sprinkler used in some parts of the U.S.A. is the pull-type wheel system. A fixed or swivelling two-wheeled carriage supports the sprinkler lateral 12 or more in. above the ground. The lateral is then towed endways by a tractor or light truck to the new setting. Pull-type systems are used on close-growing forage crops. Some farmers plant grass strips in row crops and use these strips when moving laterals of the pull-type wheel system. Cost of such equipment is about one and a half times as much as a comparable hand-move system.

Similar to the pull-type wheel system, but having a skid pan or outrigger attachment substituted for the wheeled carriage supporting the sprinkler lateral pipe, is the drag-type. The skid pan or outrigger helps to stabilise the laterals and protect the pipe from excessive wear when these laterals are being pulled across abrasive soils. Modified pull-type systems are used on well-sodded forage crops and cost slightly less than the pull-type wheeled laterals.

The side-roll, pull-wheel and drag-type laterals do not change the number of laterals used when compared with the hand-move lateral system for the same field or farm. Some manufacturers increase the size of sprinklers and their operating pressure, and



The pull-type wheel lateral is moved by being pulled endways with a farm truck or tractor

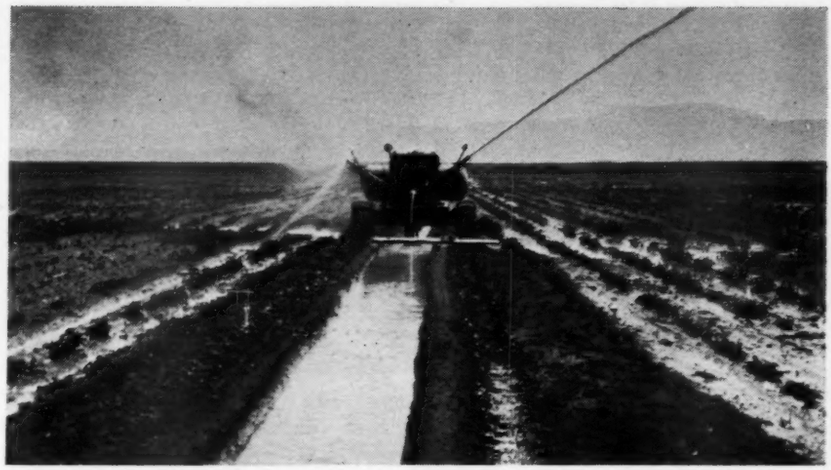
* Contribution from Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, in co-operation with the Idaho Agricultural Experiment Station.

† Irrigation engineer, Western Soil and Water Management Research Branch, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Boise, Idaho.

mount the sprinklers on a stand or trailer for moving with a tractor or light truck.

Each sprinkler has 1-8 or more nozzles. Operating pressures vary from 60-120 lb. per sq. in. with a discharge of 150-895 gal. per min., depending upon the operating pressure, nozzle size and number of nozzles on each sprinkler. The areas covered by the spray vary from 1-5 acres per set. Minimum application rates vary from 0.3 in. to over 0.6 in. per hour.

The spacing of these sprinklers in the field varies from 150-250 ft. for those giant sprinklers having one large nozzle and two small fill-in nozzles. Spacing is 225-420 ft. for the giant rotating boom-type sprinklers. Each boom has from 1-8 or even more nozzles. This type of sprinkler can be obtained with overall boom lengths of from 80-250 ft.

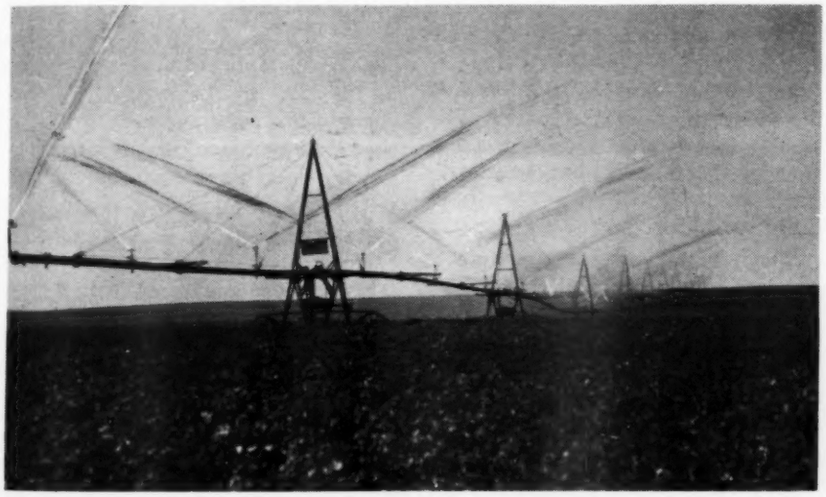


A self-propelled sprinkling machine consisting of a 1,100 gal. per min. pump, two giant part-circle sprinklers, a diesel engine and portable dam mounted on crawler tractor treads. The machine travels one mile in 20 hours. Note the two levels of the water in the ditch

Giant sprinklers

Giant sprinkler systems have more troubles with high winds than the usual hand-move systems due to their higher operating pressure, finer spray and wider spacing of sprinklers. Some of these giant sprinklers can be used only on soils with high infiltration rate. Others can only be used on fairly level ground. Most of the boom-type giant sprinklers are found in the maize and sugar-cane areas of the U.S.A. Giant sprinklers are used more in the humid areas where large areas can be covered rapidly when short drought periods occur. The cost of such a system varies from one to one and a half times that of comparable hand-move systems.

The two sprinkler system types requiring the least labour in their operation are known as the self-propelled and the solid systems. There are two distinct classes of equipment in the self-propelled sprinklers.



A 1,280-ft. long self-propelled sprinkler lateral being used for irrigating potatoes in Eastern Idaho. It rotates about a central point where water is delivered into the lateral at 900 gal. per min. at 80 lb. per sq. in. A hydraulic cylinder mounted on each 'A' frame drives the wheels which carry the lateral round in a huge circle. The unit will cover a total of 140 acres

Self-propelled rotating systems

In one class, called the rotating lateral, the sprinkler pipe is mounted on wheeled 'A' frames 96 ft. apart and tied together with cables. Large hydraulic cylinders located on each 'A' frame unit convert the normal water pressure of 60 lb./sq. in. to a 3,000-lb. force that is applied to the wheels. This force rotates the entire system in a circle around the field. At each stroke of the hydraulic piston the pipe moves a few inches. The water main is connected to the lateral at the pivot point around which the system rotates.

The lateral pipe is 6 ft. 8 in. above the ground so that it will clear tall crops like maize, cotton and sorghum without damage. The 'A' frame wheels follow the same track through the crop at each irrigation, and once the lateral has been started on a round of a field no further labour is needed. This sprinkler system will automatically turn itself off at the pump in the event of any mechanical trouble. Systems are in operation that will cover 160 acres with the one lateral. The speed at which the lateral travels can be adjusted and is dependent upon how much and how fast the soil will absorb the water, how much water is available and the size of the system.

The rotating lateral self-propelled system is best suited to a circular field. With square fields some other way must be devised to irrigate the corners not reached by the rotating lateral. In some Western potato fields this was done by operating the rotating lateral so that a three-day coverage of the circular field was obtained; the rotating lateral was then stopped and each square corner was irrigated with a hand - move sprinkler system, the rotating lateral being used as a water supply line. This allowed one 24-hour irrigation for each corner and a three-day coverage of the circular field in a seven-day peak irrigation period.

The components of an automatic solid sprinkler system. The time clock (left) *controls solenoid valve* (centre) *which temporarily drops main line pressure activating pressure valve* (right), *shutting off one sprinkler and turning on the next along the lateral*

The rotating, lateral, self-propelled systems require uniform and level ground for satisfactory operation. Large fields having deep gullies or drainageways through them need built-up roadways for the 'A' frame supports; otherwise pipe breakage will occur when a support goes over a sharp dip in the ground.

The cost of these self-propelled laterals varies from $100 per acre for 160-acre systems to $150 per acre for small systems.

Self-propelled giant sprays

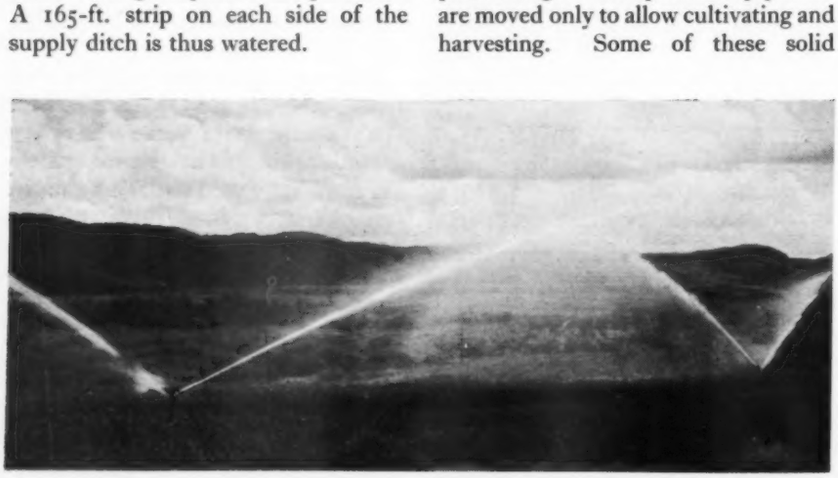
The second type of self-propelled sprinkler consists of a 1,100 gal. per min. pump, two giant part-circle sprinklers, a butane or diesel engine and a portable dam all mounted on or attached to a machine carried on endless crawler treads. The machine straddles a field ditch and pulls the portable dam along behind it to accumulate the water. The pump lifts the water from this sump and delivers it to the two giant part-circle sprinklers. A 165-ft. strip on each side of the supply ditch is thus watered.

The supply ditches are spaced 330 ft. apart in the field and the unattended machine travels one mile in 20 hours down each in turn. At the end of one ditch the machine stops, the operator then drives the machine over to the next ditch and starts it back up the field. The engine powering this machine is protected by a pressure switch and heat control switch which will stop the engine if trouble develops. This machine applies water at a very rapid rate and is best suited to soils having a high infiltration rate. Uniformly sloping land is needed so that the ditches can be equally spaced. The cost of this type of system is about equal to a hand-move sprinkler system.

Solid sprinkler system

The least labour for operating is required by the solid (or established) sprinkler system. These may have permanent or portable components, but have enough laterals to irrigate a field without disconnecting and repositioning. The portable pipelines are moved only to allow cultivating and harvesting. Some of these solid systems are operated as blocks of laterals with all the sprinklers operating at the same time. This requires lateral pipelines of the same diameter as a portable lateral system of the same size. The recent introduction of a pressure-operated valve to allow operation of only one sprinkler on a lateral at a time made possible the use of smaller lateral pipelines in these solid systems.

A momentary interruption of the water pressure in the system will change operation from one sprinkler to the next on the lateral. These changes are done automatically by a time clock that momentarily interrupts the pressure either by shutting off and starting up the pump or by shutting off and turning on an electric solenoid valve located on the main pipeline. This activates a valve located on each sprinkler riser with the result that the sprinkler operating on that lateral is shut off and the next one on the lateral is turned on. This procedure is repeated until each sprinkler on the lateral has operated, then by interrupting the pressure for a longer time, one minute or more, the cycle of sprinkler operation is repeated. Solid systems of this type cost from $300-$500 per acre. The cost limits their use to high-income producing crops, such as vegetables and fruit.



Giant sprinklers operating in a field of wheat. The area wetted from one sprinkler is a circle 400 ft. in dia. and the operating pressure is 120 lb. per sq. in.

Automatic operation

Many automatic lawn sprinklers are being installed by golf clubs, factories and home owners. Most of these are controlled by time clocks, operating solenoids or hydraulic valves, with a few installations having soil moisture probes or tensiometers controlling the time and amount of water applied. Agricultural sprinkling developed from

lawn sprinkling in the cities. Is this process being repeated with automation in sprinkler irrigation?

Summary

Most sprinkler systems in the U.S.A. are portable or semi-permanent types having hand-moved laterals. The mechanisation of these hand-move laterals began with the development of the powered side-roll, the pull-wheel, dragline, giant sprinkler, self-propelled and solid systems. These inventions, while as yet used only on a part of the total sprinkled acreage, will be introduced more generally as soon as they are proved to be economical on a large scale. These mechanised systems will require a larger capital investment, but will reduce labour costs and so justify their higher cost.

Sprinkler irrigation in the U.S.A. started 60 years ago. It has grown until about 10% of the total irrigated acreage of almost 38 million acres is now sprinkler irrigated. It is increasing at the rate of 200,000 acres per year and it is expected that sprinkler irrigation will be used more and more in the future.

Coming Events

Horticulture.—The Chelsea Flower Show will be held at the Royal Hospital, London, from 16-19 May. Particulars from the Royal Horticultural Society, Vincent Square, London, S.W.1.

Crop Protection.—The 13th International Symposium on Crop Protection will be held in Ghent on 7 May. Enquiries should be addressed to: Prof. Ing. J. Van den Brande, Institut Agronomique de l'Etat, Coupure Gauche 233, Ghent, Belgium.

Fertilisers.—The Fourth Congress on Fertiliser Problems will be held at Opatija, Yugoslavia, from 9-12 May, 1961. Applications to: Secretariat General, C.I.E.C., Beethovenstrasse 24, Zurich, Switzerland.

Grassland Research.—The Grassland Research Institute at Hurley will hold its Open Days this year on 27 and 28 June. Members of the public are invited to attend and may obtain further details from the Institute, Hurley, nr. Maidenhead, Berkshire, England.

Fruit Spraying.—There will be a top fruit spraying machine demonstration on a farm near Sittingbourne, Kent, England, on Friday, 2 June. Admission free. Particulars from the Secretary, Royal Agricultural Society of England, 35 Belgrave Square, London, S.W.1.

Tropical Agriculture.—A Preparatory Course in Tropical Agriculture has been arranged by the Oxford University Committee for Commonwealth Studies from 3-15 July. There will be no charge for the course other than for accommodation in Oxford. Enquiries should be addressed to Mr. G. B. Masefield, Department of Agriculture, Parks Road, Oxford.

The U.K. Branch of the Imperial College of Tropical Agriculture Association will hold an open meeting in London on Friday, July 21. One of the speakers will be Mr. Gordon Wrigley, of Fisons Pest Control Ltd., who will speak on 'Agricultural Chemicals and Their Use in Tropical Agriculture'. Further details will be announced later. Particulars may be obtained from Mr. E. G. Wright, 28 Highfield Drive, West Wickham, Kent.

Russian Trade and Industry.—The Soviet Exhibition to be held at Earl's Court, London, from 7-29 July will present a picture of Russian life, culture, work and achievements in economy, science, technology and agriculture. A particularly large section of the Exhibition will be devoted to agriculture. Further information may be obtained from Industrial and Trade Fairs Ltd., Commonwealth House, New Oxford Street, London, W.C.1.

Agricultural Economics Extension.—The Ninth International Training Centre on Methods and Programme Planning in Agricultural and Home Economics Extension will take place at Wageningen, The Netherlands, from 12 July-6 August. The meeting has been arranged by the International Agricultural Centre, under the auspices of FAO and OEEC and with the support of the State Agricultural University. Full details may be obtained from the Director, International Agricultural Centre, 1 Generaal Foulkesweg, Wageningen, The Netherlands.

Irrigation.—An International Course on Irrigation in Sub-tropical Regions will be held at Emek-Hefer, Israel, for six weeks from 1 August. Particulars from: Irrigation Extension Centre, Post HaMidrasha LeHaklaut, Emek-Hefer, Israel.

Agricultural Exhibitions

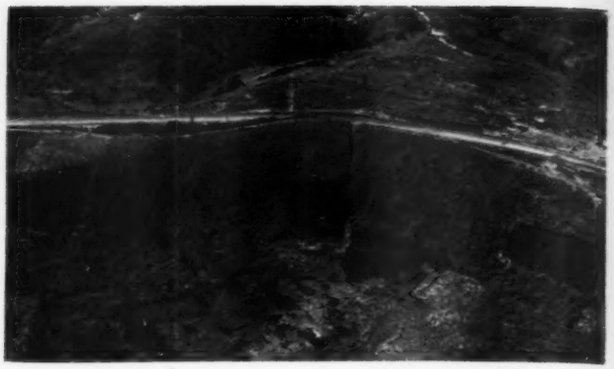
S. Rhodesia.—A Central African Trade Fair and Exhibition will be held in Bulawayo from 3-14 May. Details from the Development Officer, Bulawayo Agricultural Society, P.O. Box 1776, Bulawayo.

Sweden.—A European Agricultural Fair will be held in Jonkoping from 25 May-4 June. Apply to: European Agricultural Fair, Jonkoping, Sweden.

New Zealand.—The Waikato Agricultural Winter Show will be held in Hamilton from 30 May - 6 June. Details from the Waikato Winter Show Association, Box 616, Hamilton.

England.—The Royal Show will be held this year in Cambridge from 4-9 July. Enquiries to the Secretary, Royal Agricultural Society of England, 35 Belgrave Sq., London, S.W.1.

Congo.—An International, Commercial, Industrial and Agricultural Exhibition has been planned from 8-23 July in Elizabethville. Information from the Secretary-General, Elizabethville International Fair, 2180 Avenue Leman (P.O. Box 1916), Elizabethville, Republic of Congo.



Photos: Kenya Inf. Services

Left: *Meru labourers preparing the ground for the tea seedlings to be transplanted from the nursery.* Right: *Aerial photograph of terraced plots belonging to African farmers in the Nyambeni Forest, now planted with tea*

World News

Kenya

African-Grown Tea

Africans in Kenya already grow tea in areas around the eastern Aberdare Mountains and the southern edge of Mount Kenya. A new area is now being developed in the Meru district, where the Nyambeni forest covers a range of hills. This forest area, at about the 6,000-ft. contour, has an annual rainfall of between 70 and 80 in. and is expected to prove one of the finest tea-growing areas in East Africa.

The Colonial Development Corporation, together with a commercial tea company, Eastern Produce (Holdings) Ltd., and the Meru African District Council, have formed the Nyambeni Tea Co. Ltd. to develop 500 acres of tea on land set aside from the native land unit and to build a tea factory which will come into operation in abour four years' time—with an ultimate production capacity of about 1 million lb. of high-grade tea a year. Provision has been made for Africans to purchase up to one-third of the company's total share capital in due course, so that local Africans may play an increasingly important part in the development and share in the prosperity of the company.

Dense virgin forest has been cleared both by hand and using heavy mechanical equipment, and the first 100 acres of the planned 1,200-acre development scheme have been planted. Local Meru smallholders will thus have the opportunity of growing tea and selling their green leaf to the factory for manufacture and sharing in the profits of tea sold by the company.

U.S.S.R.

Agricultural Science Centre

A new agricultural research and educational centre is to be built near Moscow. It will occupy 148,200 acres, nearly half of which is forest land.

The area will be preserved and form natural parks within the boundaries of a future town with a population of about 60,000.

The U.S.S.R. Academy of Agricultural Sciences and agricultural research institutions will be transferred from Moscow to the new centre, where new scientific institutions, including a big computing station, is also to be built.

New Zealand

Colombo Plan Students

A record number of new Colombo Plan students from South and South-East Asia are expected to go to New Zealand for training during 1961.

Already this year 17 students have arrived for training and another 120 from 11 countries — Vietnam, Indonesia, Burma, Ceylon, India, Malay, North Borneo, Pakistan, Sarawak, Singapore and Thailand—are expected before May.

This was in addition to eight U.N. fellows who were coming to New Zealand under technical assistance programmes, 10 scholars who would take post-graduate courses at New Zealand universities under the Commonwealth scholarship and fellowship plan, and a small group of students expected under the new special Commonwealth aid to Africa plan.

Paraguay and Brazil

Bridge Will Facilitate Trade

A new bridge across the Upper Parana river between Paraguay and Brazil is expected to increase trade between the two countries and contribute to the agricultural development of this region of Paraguay.

The new bridge will be the final link in a road running from Asuncion, the capital of Paraguay, to the Brazilian seaport of Paranagua. The cost of the one-third mile long bridge is being borne by Brazil, which has made Paranagua a free port for Paraguay. The new route will provide Paraguay with another outlet to the sea, as formerly almost all of Paraguay's overseas trade has moved by river or by railroad through Argentina.

The Parana Plateau of Eastern Paraguay, through which the new route runs, is largely virgin forest considered suitable for agricultural development; but it has always been handicapped by lack of good roads. Paraguay signed an agreement with Japan in 1959 for the settlement of 85,000 Japanese workers in Paraguay over a period of 30 years. Most of the land purchased for this purpose is in the Parana Plateau region near the new route.

A Development Survey in Tripolitania

2—Irrigation Projects at Tauorga

S. G. WILLIMOTT, D. W. GILCHRIST SHIRLAW, M. E. FRISBY and J. I. CLARKE

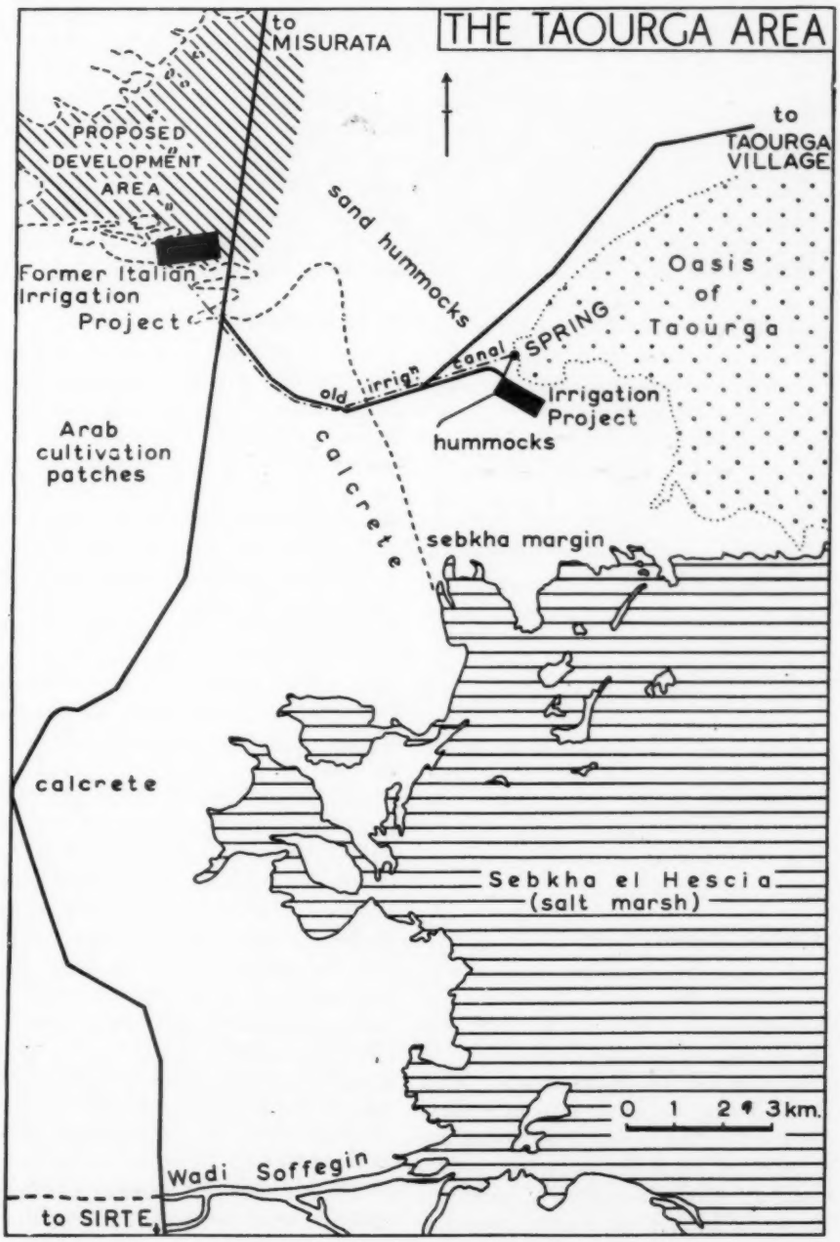
Part 1 gave a general account of the surroundings of Tauorga Oasis. This second part gives the results of a more detailed survey of the water resources and indicates the possibilities of a further extension of irrigation agriculture in this region.

IRRIGATION projects on any scale involve considerable engineering works and the expenditure of substantial sums of public money. Before any decision as to the suitability of new land for irrigation development can be made, a sound detailed survey of its various characteristics is essential. Such surveys are usually of such magnitude as to be beyond the financial resources of the governments of underdeveloped territories; hence, until such time as local personnel can be trained to undertake increasing programmes of investigation, specialists and organisations from overseas have to be called in.

After the completion of the reconnaissance of the soil and water conditions in the region it was possible to study two selected areas in the vicinity of the Tauorga spring, which merited more detailed investigation for irrigation agriculture (see map):

1. The proposed development area.
2. The Tauorga Project (the former L.A.J.S. Irrigation Project*).

Essential to the development of the two selected areas was the feasibility of using either the waters of the Tauorga spring or, alternatively, artesian water of similar origin should it prove to be available in the immediate locality. Of equal importance was the need to ensure that an efficient drainage system could be provided as a safeguard against the hazards of excessive salinity and alkalinity, which since antiquity have prevented the agricultural use of large areas.



* Libyan American Joint Services, as a Libyan branch of U.S.O.M., was absorbed into the Ministry of Agriculture in December 1960.

Left: *Fig. 1. Arab cultivation patch in the proposed development area. Rarely is the vegetation entirely cleared before cultivation.*
Right: *Fig. 2. Well used for watering camels and mixed flocks of sheep and goats*

Proposed development area

The area comprises about 20 sq. km., lying mostly to the west and the remainder to the east of the main Misurata-Sirte road. The north-south axis along the main road extends to 6 km. and the area is flat and compact, although a slight general inclination is perceptible towards the east.

Topographically it is an extensive shallow basin into which the two main wadi systems, the Wadi Gilgel and the Wadi El Hauat, debouch from the west. To the north-west and the south the area is well defined by the presence of scarps of exposed calcrete mantled to some extent by shallow, stony soils. Small, isolated, flat-topped outliers of calcrete, ovoid in shape and prominent, are found scattered in the western section. The eastern boundary is limited by the presence of hummocks and characterised by increasing sandiness and salinity, and by poor drainage.

With the exception of the eastern and northern margins, where fine blown sand accumulates, hummocks are rare. Local changes in vegetation can be clearly associated with the depth of soil and also with the scattered Arab cultivation patches. The scarps of calcrete and the cultivated wadis were the only land forms readily delimited by aerial reconnaissance.

Earlier Italian project

In 1937 an irrigation project was developed by the Italians in the southern part of this area and extended to 75 ha., *i.e.* totalling about 4% of the proposed development area. This project was located at a point nearest to the Tauorga spring, to which it was connected by major irrigation works, now derelict. Moreover, there seems little doubt that the original intention was to take the water northwards.

Two factors operated against the implementation of this scheme: the discovery and exploitation of artesian aquifers at Tammina and El Kararim and the intervention of the Second World War. At present the area is used by local tribes for livestock grazing and for the scattered shifting cultivation of cereal crops. It is also increasingly exploited for brushwood for sale in Misurata.

Field methods

As no suitable base maps or sets of photographic mosaics were available, an air reconnaissance of the Tauorga region was made and a number of oblique photographs were taken. After delimiting the area it was first surveyed and then mapped on a scale of 1:10,000 by the help of white marker cairns, sited to facilitate recognition in an otherwise featureless terrain. Sites for profile pits and numerous supporting boreholes, taken with a Jarrett auger, were planned so as to cover adequately the whole area and to provide a density of at least four points per sq. km.

Soil samples from profile pits and boreholes were taken for preliminary analysis in Libya and for more detailed analysis in Durham. Infiltration tests were made at each profile pit, using a Musgrave-type metal cylinder driven into the soil to a depth of 8 in. To facilitate the experimental work a field laboratory was fitted up at Misurata capable of carrying out estimations of soil reaction, colour and specific conductance.

Soil groups

These profile pits revealed definitely differentiated horizons and so their interpretation supplies the key to the understanding of the soil and water characteristics of the area. The depth of root penetration and the presence of a variety of soil animals are striking features. In general, there is a predominant vertical succession of horizons from loam to sandy loam to loamy sand, passing into grey-white sandstone-like material at depth.

In places the topsoil is obscured by a thin layer of fine wind-blown sand, especially in the eastern part of the area. This can have the effect of transforming the texture of the surface horizon to a sandy loam. Along the eastern boundary higher hummocks are associated with the prevalence of loamy sands.

A feature of the soils of this terrain is the presence of a very thin surface crust, up to 1 cm. in thickness, in part the result of evaporation. This crust is fragile, exhibits a weak granular structure, and varies in texture from loamy sand to sandy loam. Sinkholes, such as occur in the vicinity of the Tauorga project, are absent.

The depth of cultivable soil, so important in irrigation schemes, shows considerable variation, but is usually not less than 60 cm.; the maximum soil depth recorded was 148 cm. In the western section, soil depths exceeding 80 cm. are not uncommon. On the other hand, in the eastern part the soil depth rarely exceeds 80 cm. and more usually falls between 60 and 70 cm.

The reaction of the soil varies between a pH of 8.0 and 8.5 and no local pattern is detectable. The majority of the soils are characteristically of quite moderate salinity, though more strongly saline soils are developed towards the east of the area as a whole.

Of special interest is the finding that non-saline soils (soluble salts less than 0.2%) occur along the western margin higher up the wadi beds. From the points of view of both texture and depth it may be concluded that much of the soil is suitable for irrigation. Moreover, the generally moderate salinity encountered would not appear to present any problem.

Soil water movement

By means of boreholes it was ascertained that the ground water table is below 2 m. throughout the area. Infiltration is satisfactory though variable; infiltration rates were found to range from 1.8-7.3 cm. per hour. In the majority of cases the soils reveal an infiltration rate between 4 and 5 cm. per hour; lower rates are associated with the more compacted soils.

Future development

The proposed development area was the most promising of the areas studied, as well as the largest. Since the principal objective of the survey was to assess the suitability of the area for irrigation agriculture, the system of classification, based on all the field and laboratory data available, was that for irrigated land use prescribed by the U.S. Bureau of Reclamation. This system recognises six land capability classes and on this basis the majority of this area would fall into Class 2*s*, although lower classes of land were present.

Development would necessitate major irrigation and engineering works and probably on a scale larger than those of the old Italian scheme. An irrigation project could be based either on the Tauorga spring, approximately 8 km. distant, or on local artesian water known to exist. A decision between these two alternative sources could only be reached after the completion of a hydrological survey of the Tauorga region and detailed costing. There are obvious advantages, should it be considered feasible, to bring into operation the already existing supply at Tauorga, which should be adequate to water an area of 20 sq. km. The work of reclamation should present no great difficulty, as the area is compact, accessible and reasonably uniform.

Tauorga Irrigation Project

The Tauorga Irrigation Project was initiated by L.A.J.S. in 1957 to provide forage for local livestock. At present the area under irrigation extends to 40 ha. and is situated 1.3 km. SSW of Tauorga spring. There have been three annual phases of development and this allows the effect of three successive stages of leaching to be studied.

The land immediately adjacent to the project was included, first to give a comparison with virgin soil, and second to provide a basis for a recommendation on the possible extension of the project. The area was surveyed and mapped on a scale of 1:4,000.

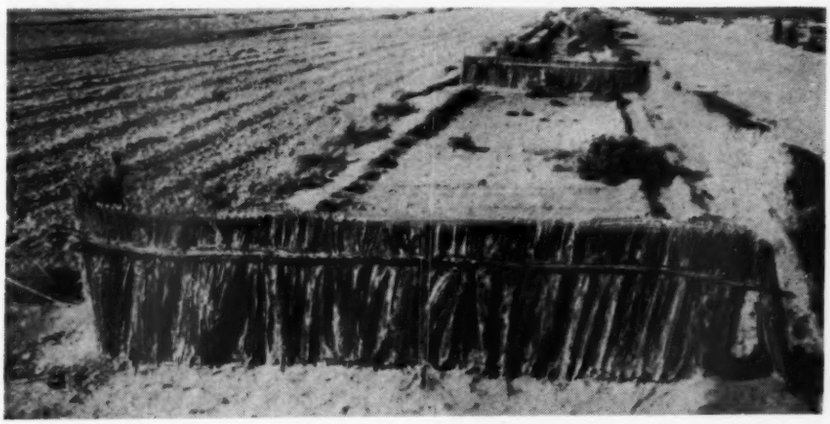


Fig. 3. Margin of the irrigation project at Tauorga, showing nursery in foreground

Soil characteristics

The most common soil profile in the irrigated area shows a sandy loam overlying a more compact silty clay. The spasmodic occurrence of a black organic horizon at approximately 60 cm. depth is suggestive of the soils being laid down under swamp conditions and being subsequently covered with aeolian deposits, and so may be classified as aeolian-lacustrine soils. The depth of cultivable soil shows some variation, but is usually about 55 cm. The profiles along the drainage ditch reveal the heterogeneity of the soils in this area, as is to be expected from a consideration of their mode of origin.

The reaction of the soil varies between a pH of 8.0 and 8.8, but there are no marked differences between the three project phases, though the unleached soils tend to be more alkaline than the leached soils. It was noteworthy that irrigation had not resulted in an increase in the alkalinity of the soils, probably because of the presence of adequate quantities of gypsum. At least in the immediate future continued leaching should produce no deleterious effects so far as alkalinity is concerned.

The figures for salinity also exhibit wide variations throughout the area. In general, salinity tends to decrease with depth and there are indications of a reduction in salinity as a result of irrigation. Furthermore, there is no well-defined zone of salt accumulation, and this again suggests satisfactory leaching operations.

Drainage conditions

The area is almost flat, but there is a gentle slope towards the south. Some low hummocks occur to the north-west, where the vegetation is typically halophytic. A drainage ditch 1.4 km. in length runs in a south-westerly direction, although it is questionable whether the direction of flow or present depth allows it to fulfil the purpose for which it was intended. Under-drainage must be adequate.

Ground water was found at 154 cm. in the centre of the project, at 160 cm. to the west and at 127 cm. to the south; in each case the water was found below a clay horizon. Infiltration measurements, both in and around the irrigation project, showed wide variation. With water of Tauorga quality a higher infiltration rate than normally regarded as minimal would be necessary for the sustained success of irrigation agriculture. Patches of low infiltration may explain partial crop failures of maize observed in some of the plots.

Future development

A general classification for this area

(*Continued on page* 196)

Photos: Shell

Left: *Stumps of Alisma one month after treatment with slow-release 2,4-D pellets at 20 lb. a.e. per acre.* Right: *A similar fen dyke six months after clearing by cutting alone*

Progress in Weed Control

5—Weeds of Waterways

THE eradication of aquatic weeds is a somewhat specialised problem of weed control. Broadly speaking, water plants can be divided into three groups: emerged species (*e.g.* reeds, bulrushes and sedges etc.); submerged or floating species (*e.g.* pond weeds, water lilies and duckweed) and algae (*e.g.* stonewort and 'scums', 'slimes' and 'blanket weeds'). Each of these groups present their own particular problems.

If the situation has not become too far out of hand, it is often possible to reduce weed growth to within reasonable limits by mechanical methods and manual operations, but these methods are expensive and will become more so with rising labour costs. The result is that weed control in ditches, dykes and drains may become increasingly neglected, with a serious effect on agriculture.

The river boards and drainage authorities of Britain are usually well equipped with weed-cutting boats for dealing with the problem of aquatic weeds in navigable channels, but it is the smaller watercourses which present the more difficult task, for the major part of the work has to be carried out by hand.

It is only natural, therefore, that those concerned should now be forced to consider the possibilities of chemical weedkillers. The papers, which describe the results of aquatic weed control work done in 1959 and 1960 and which were presented at the Fifth British Weed Control Conference last year, are here summarised.

Experiments on the Chemical Control of Emergent Water Plants *by R. J. Chancellor (A.R.C. Weed Research Organisation)*

Investigations into the use of 2,4-D have shown that useful effects on emergent water weeds in general cannot be obtained. However, the advent of dalapon, specific to certain monocotyledons and grasses, has provided a possibly suitable chemical treatment, because most large emergent water plants are grasses or are closely allied to them.

This paper described experiments with certain chemicals to control emergent water plants. The effects in each experiment were assessed in the year after spraying. All important water plants were considered and also some of lesser importance and a table of susceptibilities was given at the end of the paper.

The results show, in general, that dalapon at doses in the range of 10-40 lb. of dalapon (acid equivalent) per acre gave satisfactory control of important emergent water weeds, although occasional failures were recorded.

Thus one experiment indicated the useful selectivity of dalapon and the change in the composition of the vegetation that has taken place. This shift in populations of different species was beneficial as far as the maintenance of watercourses is concerned. The resistant species that increased in abundance cannot be regarded as undesirable, for they were small and unlikely to impede water flow and might, in fact, be useful in holding mud and preventing it eroding.

A rather different change in flora, however, occurred on the river bank in another experiment. The reduction of *Glyceria maxima* allowed a number of plants to colonise the area; of these, the new dominant species, *i.e. Urtica dioica* and *Epilobium hirsutum*, cannot be considered desirable.

A third type of result was seen in a shallow ditch, where a mixed stand of water weeds was cleared and remained clear for at least 10 months after spraying.

All the experiments fall into one of these three categories. In some it would be difficult to forecast what the change would be. These were the areas where all species present were susceptible. Where there were mixed susceptible and resistant plants, the resistant species were likely to spread over the area.

Chemical Control of Weeds in Farm Dykes *by J. M. Proctor (N.A.A.S., Eastern Region)*

The maintenance of free water flow in dykes is directly related to weed growth. Weed clearance by physical methods is laborious and costly and during the time of maximum growth dykes may be so clogged that there might be a danger of flooding should heavy storms occur.

Field-scale trials have been carried out by the Crop Husbandry Department, N.A.A.S., Eastern Region, and the following materials have been tested to determine their suitability for the control of weeds in dykes: acrolein, liquid; simazine, atrazine and trietazine in the form of the 50% wettable powder; 'Chlorea' and 'Monax', which are pelleted 'complete' herbicide mixtures containing monuron.

While those chemicals giving total weed control may have an occasional place on the farm, the rates necessary are heavy and a danger to crops could arise when dykes are dragged out. Of those tested, atrazine would seem most effective. Atrazine, and to a lesser extent simazine, appeared to have some value for the control of vegetation in marshy-bottomed dykes.

Acrolein gave a rapid kill of broad-leaved species in stagnant water, but application was difficult and control of some species was short-lived. Acrolein might have value where the rapid killing and collapse of vegetation was required in emergency conditions. The particular value of acrolein would seem to be its ability to give a rapid kill of aquatic vegetation, but the difficulty of applying it and the danger to fish suggest that it is unlikely to be used on a wide scale. In any case, it would require to be handled by a trained operator.

Acrolein compares unfavourably with 2,4-D pellets so far as persistency of control is concerned. Good results were produced by 2,4-D pellets and pellets appeared to be a very suitable formulation for dyke work. Some excellent control was obtained of a wide range of broad-leaved species in near-stagnant water.

The Development of Aquatic Weed Control *by F. R. Stovell (Shell Chemical Co. Ltd.)*

Emergent species of water weeds may be tackled relatively easily by means of a spray application to the

Photo: Dow Agrochemicals Ltd.

The reeds in this drain in the Fen country have been cut periodically but have never been sprayed with Dowpon. As a result, the waterchannel is seriously impeded by reeds that grow in the water, and the whole drainage system is choked

aerial shoots, but the principal restriction to water flow is caused by submerged weeds. The majority of these submerged species are relatively simple organisms and susceptible to chemicals used for dry-land weed control. The problem lies in the method of treatment and the selection of the most suitable material.

The paper described five trials using acrolein formulation (EF 1015) and three trials with 2,4-D pellets for the control of submerged aquatic weeds carried out during 1959 and 1960. A method of using EF 1015 in static water was given and the danger to fish was discussed. Resin-based 2,4-D pellets of very low toxicity to fish were described. Their use is effective in static and slow-moving water, but may provide hazards if used for crop irrigation.

Rainfall during the season of 1960 was much higher than in 1959 and it appeared that the water flow through the dyke affected the action of the chemicals. It is possible that the action of the water on the pellets may be affected by its pH, but it appears that the main route for the toxicant is through the leaves and not via the mud and roots, as was originally supposed.

The action of the pellets was to produce a local solution of 2,4-D. Assuming immediate release of all the chemical, with no loss by absorption or by breakdown, the strength of a solution in a dyke only 6 in. deep would be approximately 14.5 p.p.m. In practice the release only occurred slowly and there would be losses by absorption and breakdown, so that the operating concentration must be considerably lower.

It appeared that, while 2,4-D pellets showed considerable promise for the treatment of some species of aquatic weeds in stagnant water, the likelihood of the method working in flowing waters was much less, decreasing with increasing rate of flow. In all cases the end use of the water must be borne in mind.

Photo: Crown Copyright

Reed invasion of arable land. At one time the whole of this area was reed infested. The foreground area was treated with dalapon and the background was untreated. The contrast remained a year later

Control of Reeds in Arable Land with Dalapon *by J. M. Proctor (N.A.A.S., Eastern Region)*

Reeds, *Phragmites communis*, which occur commonly in dykes in the fens, often invade the adjacent arable fields. Infestations are normally most serious along headlands, but may extend over a large proportion of the field, interfering with hoeing and presumably reducing crop yields by competition. In the past, invasions have been accepted as one of the difficulties of farming in certain areas of fen, there being no practical method of control.

Recent trials have shown that dalapon rapidly killed leaf growth, although the rhizome gave no very definite signs of having been affected when examined prior to summer emergence of the shoots.

Further work is clearly necessary to determine the most effective stage of application and to assess optimum dosage more critically. It would appear, however, that 15 lb. a.e. per acre of dalapon* can be expected to give good control of reed, provided it is applied when there is a good growth of leaf.

* Used as the commercial formulation 'Dowpon'.

A Development Survey in Tripolitania

(*Continued from page* 193)

would be Class 3sd(a). The results so far available reveal no good reason for abandoning this irrigation project; on the other hand, there is no real evidence that it could be greatly extended. The most suitable land for a possible extension lies towards the south, where perhaps another 20 ha. could be included.

The area towards the south-east would be ruled out by the poor soil depth revealed in the early reconnaissance; to the north-west the low hummocks of blown sand overlie heavy textured horizons with correspondingly low infiltration rates; indurated horizons also occur extensively towards the south-west. All the soils in the vicinity of the irrigation project are extremely saline and even towards the south heavy leaching would be required. This would render irrigation inefficient.

Conclusions

Four main conclusions emerge from the results of the survey. First, the existence of abundant water supplies and the proximity of a considerable extent of good soil in the proposed development area offer good possibilities for expansion of irrigation agriculture. Nevertheless, a hydrological study of the Tauorga region is an essential prerequisite to any development plans. Secondly, the irrigation project at Tauorga must be limited in area. Extension to the south, though practicable, scarcely merits implementation. Thirdly, the afforestation of selected areas throughout the region is important, especially in the vicinity of irrigation projects. Lastly, the human problems involved in development present real difficulties, especially when dealing with the resettlement of nomadic peoples.

To minimise the social and economic upheaval involved would be a wise precaution. Moreover, the history of the settlement of nomadic peoples has shown that any development must be long-term in its vision and enlightened in its enforcement if it is not to end in frustration and failure. It is to be hoped that the revenues arising from the recent oil strikes in the Sirte area will soon become available for the advancement of urgent agricultural projects in Libya.

Water Control Measures

The idea of using stream deflectors to control and direct the current of a river has been introduced by R. I. Batalin, a technical expert of FAO, into the Kushtia irrigation project in East Pakistan.

There is an enormous variety of these floating and fixed deflectors; basically they are rectangular in shape —some 3-5 yd. long and 2 yd. high— in cross-section and mostly curved facing the flow and straight behind. They are usually arranged in connected sets, often one behind the other in a rising slant and, depending upon local conditions, may be placed at any depth from stream bed to its surface, and they are secured either from the stream bottom or by floating pontoons.

Transverse current circulation is thus artificially created and a considerable degree of control can be achieved over stream flow, turbulence, deposition of sand or silt, and such problems as straightening of banks through an artificial scouring process. Two such installations are to form an integral part of the project—one is to be at the mouth of the intake canal to prevent silting and blocking, and another is to exert a scouring action in the Gorai River.

This Kushtia project is the nearly completed first stage of the Ganges Kobadak scheme, a large-scale, long-range irrigation and flood control programme initiated by the East Pakistan Government as a means of increasing agricultural production.

The problem in this area has always been the uncertainty of agriculture based on floods and the rains. In the wet season, July-October, high rainfall in the Ganges and Brahmaputra valleys caused heavy flooding with fast rising waters, while in the dry season agriculture has suffered from a general shortage of water, turning to drought just before the beginning of the rains.

The conservation programme now in hand includes the construction of flood embankments, earth dams, drainage channels and a network of irrigation canals. The first phase will cover 135,000 acres and ultimately the Ganges Kobadak project will be extended to some 500,000 acres.

Irrigation water will be admitted to the Kushtia system this year. The construction of the Kalinganga Dam and the pumping station and installation of pumping equipment is now under way, while the 10,000-kW power house for the pumping station is already finished, as is construction of the main and secondary canals. The power house was supplied by Canada through the Colombo Plan, while the U.S.A. has supplied the water-gates, construction machinery and pumping plant equipment through the International Co-operation Administration.

New Publications

Chemistry of Fertilisers

The Chemistry & Technology of Fertilisers. Edited by V. Sauchelli. Pp. x + 692. Reinhold Publishing Corporation, 1960. Price $18.

In the past decade there has been a remarkable increase in the production of fertilisers throughout the world and notable advances in technology of manufacture have been made. The introduction of new formulations and processes has confronted the manufacturer with a host of new problems and a detailed review of the whole field of fertiliser technology is therefore particularly welcome at the present time. This volume, No. 148 in the American Chemical Society Series of Monographs, is a complete up-to-date survey of the chemical fertiliser industry. It is, indeed, a book which progressive manufacturers of chemical fertilisers throughout the world can ill afford to be without.

The first section of the book deals with nitrogen and covers in a remarkably concise manner the conversion of ammonia to nitric acid, ammonium nitrate, ammonium sulphate, urea and urea-formaldehyde products.

Numerous line diagrams illustrate very clearly the various processes and equipment described. The more important physical and chemical properties of the various products, together with plant operating data, are given and all-important references are listed. As most of the techniques used in Europe as well as America are reviewed, it is somewhat surprising to see no mention of the gypsum or anhydrite process for making ammonium sulphate.

The section concerned with phosphorus covers some 300 pages and all aspects of the subject receive generous and exhaustive treatment. Not only are all known processes for converting phosphate rock into phosphatic fertilisers critically surveyed, but attention is also given to the geology, mining, handling and storage of phosphate rock. One chapter deals specifically with granulation processes for mixed fertilisers, while others cover phosphoric acid, ordinary and triple superphosphate, ammonium phosphate and nitro-phosphates.

In addition to a comprehensive chapter on potash, other more general aspects of fertiliser technology which receive attention include problems of caking, drying and cooling, corrosion, and effluent disposal. Liquid fertilisers and minor elements are also reviewed.

In a book of this type, to which some 20 different authors have contributed, it is difficult to maintain a uniformity of standard and treatment of the subject. This has, in fact, been achieved with remarkable success and all the contributions are of a high technical standard, broad in scope and remarkably up to date. Valuable features of the book are the excellent flow diagrams, illustrations and literature references. Minor criticisms concern a number of small printing errors, mostly at the beginning of the book, and the omission of two figures to which reference is made on p. 242.

To sum up, this is unquestionably an outstanding book which will prove of immense value to all technical personnel in the fertiliser industry.

J. H. HUDSON

Climate and Erosion

Climat et Erosion by F. Fournier. Pp. 201. Presses Universitaires de France, Paris, 1960. In French. Price 20 NF.

This is a book which will perhaps appeal more to the geophysicist than to the soil conservationist. The author sets out to discover whether there is a general relationship between the amount of erosion that will occur in any place and some climatic characteristic. He measures erosion by the amount of silt carried in rivers draining catchment basins, mainly American, since most of the available data required have been collected in America. Much of the first part of the book is devoted to a justification of this measure of erosion and to establishing a classification of climates suitable for the study. The results of the study are expressed in graphs in which amounts of erosion in 96 catchment basins are plotted against different climatic parameters, such as annual rainfall, rainfall intensity, number of rainy days per year etc. The book deals only with water erosion and the author assumes, probably correctly, that the predominant climatic factor controlling this type of erosion is some function of the precipitation.

He concludes that for a given type of climate, and particularly for semi-arid climates, the amount of erosion (D.S.) is proportional to the square of the amount of rainfall (p) in the wettest month and inversely proportional to the annual rainfall (P), *i.e.* $D.S. = k\frac{p^2}{P}$. Other factors have to be taken into consideration, but the graphs show that this relationship between amount of erosion (as measured) and rainfall characteristics does hold approximately over a considerable range of climatic conditions.

The parameter p is a measure of the intensity of rainfall. The result obtained by M. Fournier is what one would also expect from commonsense reasoning, namely, that erosion will increase with the intensity of the rainfall and decrease with the annual precipitation, since—at least in arid and semi-arid regions—the lower the precipitation, the smaller the plant cover which is the soil's natural protection against erosion. A geomorphological factor which, apart from climatic factors, must influence erosion is the relief, and another term involving the mean height and 'coefficient de massivité' (related to the mean angle of slope) of a region is added to the above equation.

Detailed statistical analysis of the data shows that this modified equation fits the data for many of the 96 catchment basins remarkably well and enables the author to conclude that the determining factors in natural erosion by water are the amount and distribution of the rainfall and the mean height and angle of slope.

The author is to be congratulated on finding an equation which seems to be valid in a number of cases, but it cannot be said that he has contributed much new to our knowledge of the mechanism or control of soil erosion. To the soil conservationist land use appears to be a far more potent factor determining the severity or otherwise of accelerated erosion than any climatic characteristics.

G. V. JACKS

World Crop Reports

INTERNATIONAL REPORTS

Barley and oats

A near-record 1960 world crop of barley and oats is estimated. The combined crop of 144 million short tons of barley and oats is 4% below the record crop of 1956.

The world barley crop is estimated at 3,380 million bushels; this has been exceeded only once, in 1956; a record out-turn in Europe this year is an outstanding feature.

World oats production of 3,920 million bushels is 5% above the small 1959 crop, mainly because of the larger out-turn in North America. The current crop, however, is well below the 1958 harvest, as well as below average.

Production of barley and oats in *North America* is 5% higher because of a substantial increase in oats; this more than offsets a reduced barley crop. Harvests of oats are somewhat larger than last year's small crop in both the U.S.A. and Canada. The U.S. out-turn of 1,162 million bushels is still well below average, however, and 18% below the record crop produced in 1958. Yields of 42.9 bushels per acre are second only to the 1958 yields of 44.5 bushels, but harvested acreage is the smallest since 1887. Unfavourable weather at seeding time over much of the country was the cause of the small acreage. Canada's crop of 456 million bushels is well above average. Both acreage and yields are above average, though acreage was less than in 1959.

Barley production in North America is estimated at 639 million bushels, 3% less than last year. There was little change in the U.S. production despite a reduction of about a million acres harvested. Canada's production, however, is about 8% smaller than last year because of reduced acreage.

In *Western Europe* barley production was at the record level of 985 million bushels. Acreage has increased significantly and in 1960 was 39% above the 1950-54 average. Yields also are high. Oats production of 890 million bushels is larger than in 1959, despite smaller acreage. It is, however, well below the 1950-54 average of 1,020 million bushels. In *Eastern Europe* production of both barley and oats is smaller than in 1959. Yields are smaller and oats acreage was slightly less than a year earlier.

Production of these grains in the *U.S.S.R.* is estimated to be near the 1959 level and well below the large production of 1958. Early season prospects for large out-turns have not been realised because of unfavourable weather during the latter part of the growing season and also during the harvest.

In *Asia* production of these crops is about the same as in 1959. A smaller out-turn of barley is offset by increased oats production, especially in Turkey and Korea. Production shows little change in *Africa*. An increase in barley production in Algeria is the main change from 1959. This is partly offset by reductions in Morocco and Tunisia.

Harvesting has just been completed in most of *South America* and definite figures are not yet available. Preliminary information indicates a reduction from the previous crop because of lower yields in Argentina. Barley production for the continent is tentatively estimated at 70 million bushels, compared with 80 million in 1959. Production of oats is placed at 75 million bushels, 5 million below the 1959 total.

A large crop of these grains is reported from *Australia*. Barley production is estimated at 68 million bushels, almost double the 1959 crop and more than double the 1950-54 average. The oats crop, estimated at 78 million bushels, is sharply above average, but well below the record of 109 million in 1958.

Rapeseed

World production of rapeseed in 1960 was slightly higher than each of the two previous years, but was still below pre-war levels. However, production in several of the producing countries varied sharply. The outstanding features of the 1960 crop are a record out-turn in Canada following an abnormally small crop in 1959 and an exceptionally small harvest throughout Western Europe.

Practically all the rapeseed grown in *North America* is produced in Canada, which had a record harvest this year. The 1960 out-turn was three times larger than the 1959 crop and was one-fourth greater than the previous record in 1957. Canadian acreage rose to a record 756,000 acres in 1960, in contrast to only 213,000 acres in 1959 and 626,000 acres in 1958.

Only two countries in *South America* produce rapeseed commercially—Chile and Argentina. Production in Chile has expanded sharply in recent years. Argentina's output is uncertain because of incomplete statistics, but is believed to be somewhat below that of Chile.

Rapeseed production this year in *Western Europe* dropped to less than two-thirds that of 1959 and was the smallest out-turn since 1956. The smaller out-turn is attributed to reduced harvests in Sweden and France. Most of the rapeseed grown in Europe is autumn sown, and in both France and Sweden the dry autumn weather of 1959 caused poor stands and reduced acreages. This, in turn, was largely responsible for the smaller crops harvested in these two countries last summer. Production in West Germany was up because of a sharp expansion in acreage, which more than offset reduced yields.

Little data is available on production in *Eastern Europe*, but there are indications that production was down in some of the major producing countries, including Czechoslovakia and East Germany.

Rapeseed is a major oilseed crop in *Asia* and the out-turn there has been relatively stable in recent years. Indian and mainland Chinese production has varied considerably from year to year, but if a decline occurs in one of the countries in a given year it is often offset by an increase in the other. In 1960 a record crop was harvested in India, but production in China is also believed to have increased. Production in Japan and Pakistan, the other two major Asian producers, was larger in 1960 than in 1959, reflecting larger acreage in both countries.

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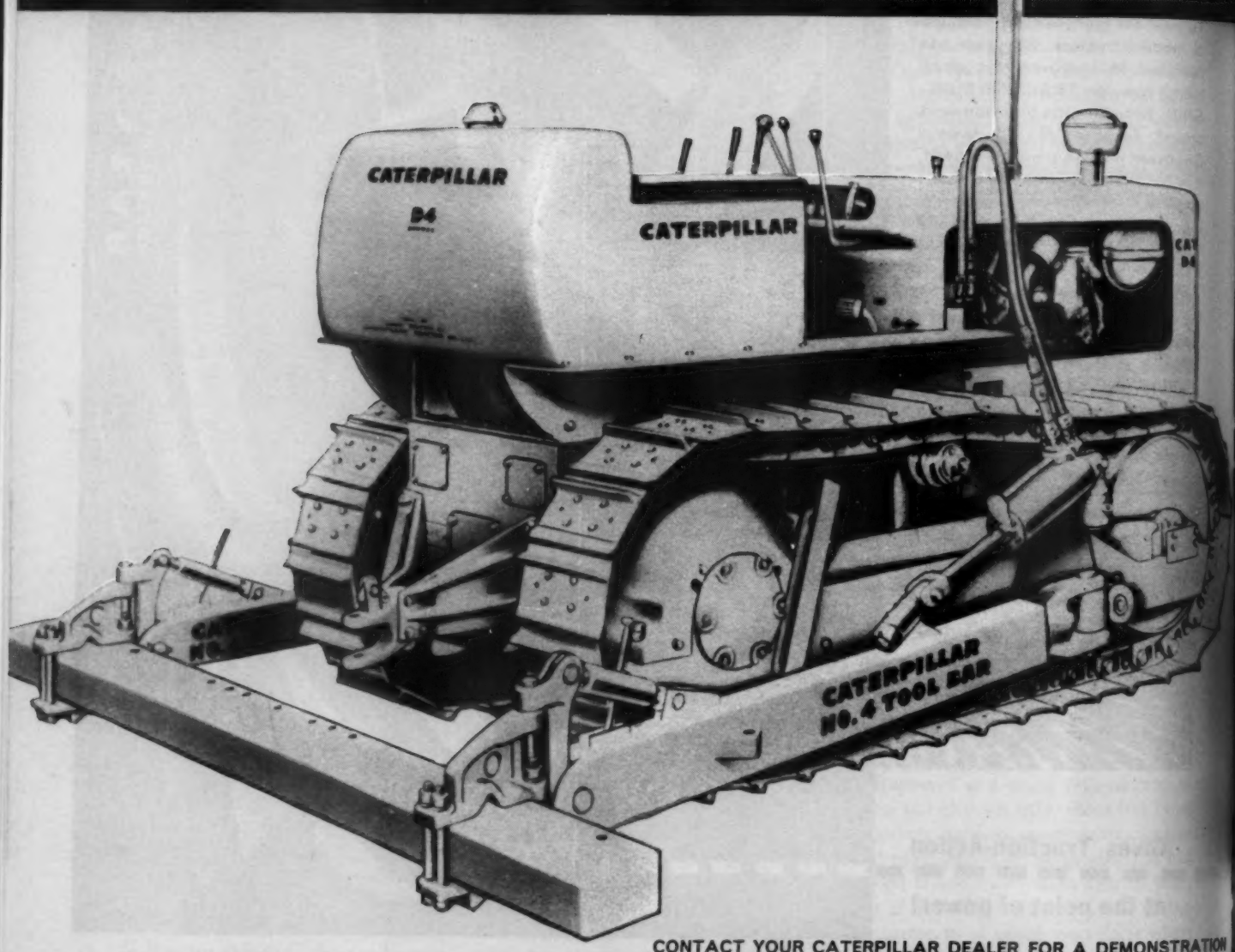

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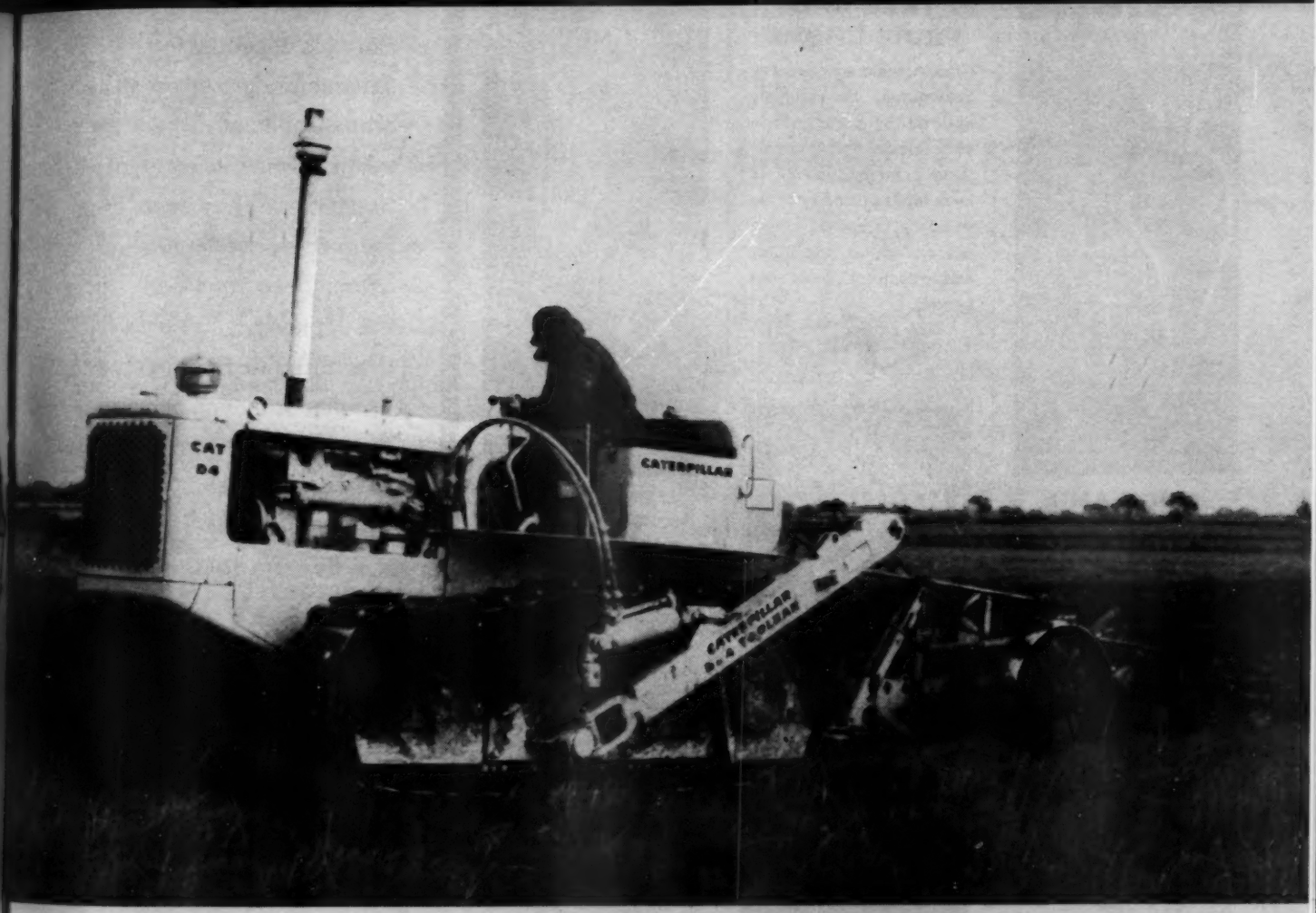

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Left: *The 'Dinkum' dumper has finger-tip control of its hydraulic steering and operation. The machine has a 13-ft. turning circle and discharges its load rapidly. The overhung engine, balanced by the load, ensures firm wheel grip. Loads of 8-10 tons can be moved in a day.* Right: *The 'Leeford' ditcher can operate close to hedges and walls. The bucket scoops its load and deposits the spoil as a neat wall of soil clear of the ditch*

Machinery and Equipment

Land Development Operations

Boreham House—the Mechanised Farming Centre of the Ford Motor Co. Ltd.—was recently the scene of a convincing demonstration of the Fordson 'Power Major' (52-h.p.) and 'Dexta' (32-h.p.) tractors, using various agricultural implements. This is an account of the implements used in land development operations, as demonstrated to a party of 31 Ford dealers from Finland.

Effective Team Work

Whitlock Bros. Ltd. were demonstrating their team—the powerful 'Dinkum 60' hydraulic excavator and the sturdy 'Dinkum 70' dumper, operating in conjunction with the 'Dinkum 66' power shovel. The first machine was used to excavate a deep trench; the second grabbed the spoil and loaded it into the dumper, which carried away the loose earth and dumped it as a filling in a land-levelling operation. All the units of this sturdy team were powered by *Fordson* 'Power Major' engines.

A further addition to this combination (not demonstrated on this occasion) is the 'Dinkum' dredger barge, which is available both as towed and self-propelled models for dumping spoil, where required, in inland waterways or lakes, or in deep water at sea.

Draining Swamplands

One of the most remarkable machines demonstrated on this occasion was the 'Leeford' ditcher, which is produced by *F. A. Hughes & Co. Ltd.* This tractor-powered implement consists essentially of a heavy tubular beam, 16 ft. long, which carries an excavating bucket on a running gear. The action of the bucket is controlled hydraulically through a bank of three double-acting rams for two-way operation mounted at the rear of a 'Power Major' tractor on a panel close to the driver. The bucket was lowered to scoop, was then lifted clear of the ditch, moved along the slide on the beam, and the spoil was ejected at a convenient point, clear of the ditch, to form a continuous bund.

The tractor was then moved forward about 4 ft. and the operation was repeated. The important point is that the tractor moved parallel to and well clear of the ditch, because the carrier beam extends 9 ft. beyond the side of the tractor. Thus there was no risk of the tractor sliding into or damaging the sides of the trench or ditch. Another advantage of this type of mounting is that it would be possible for digging to be carried out close to hedges and walls.

It was stated that the 'Leeford' ditcher can excavate to a depth of 6 ft. and still give a clean, firm finish. On this occasion it produced a ditch 18 in. wide and 3 ft. 6 in. deep in wet clay at a working rate of about 100 yd. per normal working day. This machine should find many applications on farm, forest and colonisation scheme for excavating drainage trenches, or for cleaning and deepening existing ditches.

Earth-moving Combination

The County CD-50 crawler tractor by *County Commercial Cars Ltd.* and the tilting angledozer made by the *Bray Construction Equipment Ltd.* together provided a useful combination for earth-moving, levelling and road grading. The best use is made of the 51.8-h.p. *Fordson* 'Power Major' engine, which, acting through an angled crawler track, is able to exert maximum forward thrust even in soft and slippery conditions.

Cleaning up a field drain with the JCB4. A rigid operating platform is provided by the 'A' frame, which can be adjusted for operating on sloping ground

The angledozer is designed as an integral part of this tractor and direct-acting rams ensure an 11-in. dig and a lift of 32½ in. The blade angling to 26° will produce correctly graded slopes of loose earth and spoil, or evenly cambered roads, according to requirements. Applications in plantation and estate operations are the production of in-sloping contour roads and evenly graded terrace beds. In forestry work it would be a useful tool for making and cleaning up fire-breaks.

Planting Holes in Thousands

Another built-in implement powered by the 'Power Major' diesel engine is the J.C.B.4 hydraulic excavator, which is produced by *J. C. Bamford (Excavators) Ltd.* This powerful machine is a hinged arm, which can be slewed through 180°, can dig to a depth of 13 ft., lift, discharge material at a height of 10 ft. 6 in. and reach out to 19 ft.

Perhaps its most remarkable feature is its ability to dig square holes. On this occasion it dug a hole 3 ft. x 3 ft. x 6 ft. deep (a standard planting hole for a coconut palm) in four minutes, and three planting holes can be dug from one position simply by slewing the excavating arm through its 180° arc. The cost does not appear to be prohibitive, so that vast areas can be perfectly planted with tree crops in a very short space of time. This represents a revolution in planting methods and is worth serious consideration by those concerned with opening up and developing new areas.

The J.C.B.4 is also used for land drainage, trenching, earth - moving, hedge removing, tree grubbing and ditch maintenance. One other feature is worthy of particular mention and that is its ability to cut through the hard-pan, which is so often found close to the surface in tropical soils. The machine can exert a tear-out force of 10 tons, so that the land can be properly drained and irrigated. Normally a hard-pan makes land water-logged in the rains and seriously drought-affected in the dry season.

Land Clearance, Reclamation and Settlement

Dewatering Flooded Areas

A new pump, the Sumo 'Minor', has just been announced by *Sumo Pumps Ltd.* This is a lighter version of the original Sumo drainage pump and, weighing only 93 lb., can easily be carried from place to place. It may be used for dewatering the excavations of canals while water-gates are being installed or to remove surplus water from flooded areas. It can 'snore'—sucking air and water—indefinitely and maintain the water level at 2 in.

The outlet, a 2-in. hose, can be fitted either in the vertical or in an angled position. Its output ranges from 3,000 gal. per hour at 52 ft. to 6,000 gal. per hour at 29 ft. The 2-h.p. motor requires power at 110-550 v. at 50/60 cycles.

Tree and Earth-mover

The *International* T-340 crawler tractor is primarily used on a 6,500-acre farm in Virginia, U.S.A., to load and dig trees and move topsoil to planting sites. This crawler has five forward speeds and one reverse and speeds range from 1½-6 m.p.h. Traction power is increased up to 45% by the introduction of a planetary gear unit between the engine clutch and the final drive.

Weighing 5,600 lb., this compact machine is powered by a four-cylinder petrol engine which develops an estimated 45 h.p. This gives the tractor a drawbar pull of 5,320-8,000 lb., depending on the track width and weight. It is supplied with either 38- or 48-in. track widths.

The Sumo 'Minor' drainage pump

Pure Water for Settlers

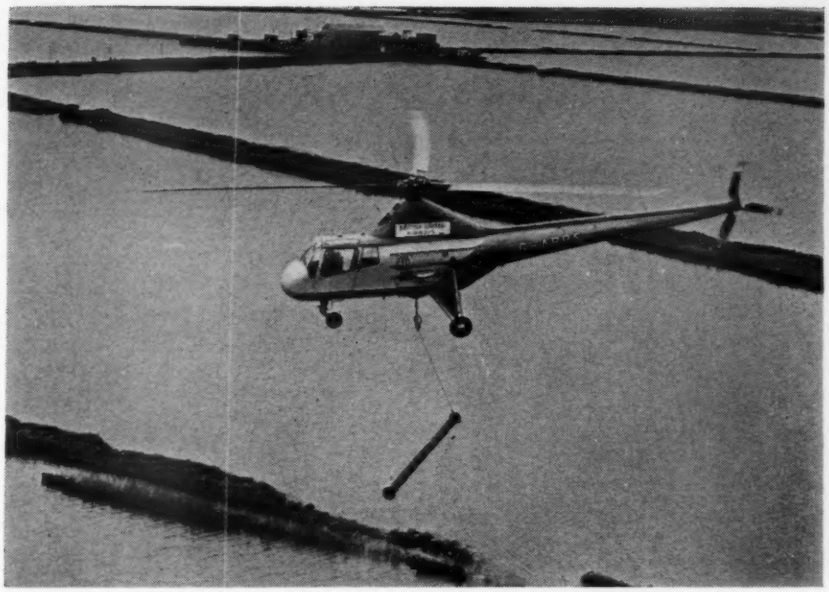
One of the problems which has sometimes to be faced when establishing new colonisation schemes in remote areas is the provision of a pure water supply for domestic or other purposes.

The laying of a pipeline over the swamplands of the tropics or the 'muskeg' or peat areas of temperate regions may present insuperable difficulties and will generally prove a costly business.

Thus, to lay half a mile of flanged 8-in. piping, each length 20 ft. long and weighing 500 lb., over a certain marshland area in Britain might take nearly a fortnight, but the whole operation could be done in under four hours' flying time at a saving of over 50% in cost.

The *Le Bas Tube Co.*, who are pipeline specialists, decided to use a helicopter to lay a pipeline across the Cliffe Marshes at Thames mouth. They used a *British United Airways* 'Widgeon' and found that it was possible to lay the length of pipeline so precisely that connecting them together was a swift and easy job. The cost of the four-hour operation was under £200; a 10-day operation by normal methods would have cost in the region of £450.

We understand that similar operations have been carried out in Nigeria and the Persian Gulf, using helicopters.



Pipe-laying by helicopter

The electric-powered, blade-studded rollers of the LeTourneau G-40 tree crusher give a tremendous traction to push down, chop and reduce trees and vegetation to the compact mat seen in the foreground

Tree Crusher and Breaker

A new mobile tree crusher designed for the rapid clearing of forested areas has been introduced to land-clearing contractors in North America by *R. G. LeTourneau Inc.*

It is claimed that the new machine, known as the G-40, will permit more acreage to be cleared per hour with fewer men and less equipment. It is equipped with three electrically-powered 6-ft. dia. steel rollers and weighs 42 tons. Moving at 3 m.p.h., the crusher pushes down trees at 5 acres per hour by means of a 20-ft. wide push bumper which applies leverage some 10 ft. up the tree to break the root system free. After the tree has fallen the blade-studded rollers reduce the foliage to a compressed mat of brushwood ready for burning.

Dealing with Overgrown Hedges

Two new mechanical hedgecutters —one the 'Avon', with hydraulic control of the cutter-bar angle, and the other, the 'Arrow', which is adjusted manually—were recently demonstrated to our representative by *Bomford Bros.* Both machines have hydraulic adjustment for the height above ground of their 4-ft. cutter bars.

One section of blackthorn hedge dealt with was exceptionally strong and a heavy side growth of bramble was invading the field. The operator first trimmed the side of the hedge vertically and the debris was cleared away to allow easy access for topping by a horizontal setting of the cutter. He then cut his way steadily along without any difficulty, sticks up to 2½ in. in diameter being easily severed.

Then the breakaway arrangement was demonstrated. On meeting an immovable object or a branch too big for the cutter bar to tackle the beam will fall back. In the working position

The 'Avon' hedgecutter seen in action. The drive from the tractor p.t.-o. is taken by V-belt to the pulley which operates the cutter bar

with the beam at 90° to the line of travel, the forward push on the hedge was said to be 300 lb. When the resistance met was greater than this, the breakaway mechanism came into action and the tension on the drive was reduced progressively as the beam was forced back. When the tractor was reversed, the cutter bar returned to its normal working position, ready for operation once more, after the stubborn obstacle had been removed.

Another interesting feature was the spring compensator in the lift ram of the beam carrying the cutter bar; the purpose of this was to ensure that when the tractor was passing over uneven ground this movement would not be reproduced by the cutter bar. Instead the 'floating' beam ensured a level steady cut even when the tractor was passing over ruts.

Tractor-cum-Lorry

This very original idea comes from Italy, where the *Organizzazione Apis* has introduced the 'Samecar' which is described as two machines for the price of one.

We already have a cross-country vehicle which can be adapted for field operations, but in this case the machine is primarily a tractor which can be converted into a farm truck which can travel over rugged country. A removable flat platform with, if required, let-down sides and tailboard can be clamped on to the two main girders.

Implements can be carried on the toolbar in front, on the sides or at the rear of a three-point linkage, or on the truck platform.

Making Forest Roads

A new range of tractor-mounted air compressors has been produced by *Atlas Copco Ltd.* to be carried and powered by the most popular makes of tractor.

The new machines, which are of the two-stage, single-acting, piston type with intercooler, are simple to operate and maintain. They are intended for mounting on the tractor's three-point hydraulic linkage, the connecting points to the tractor drawbars being adjustable. Mounting or dismounting can be carried out in a few minutes and a splined propeller shaft is provided for connection to the tractor's p.t.-o.

A typical use for these air compressors is in thickly wooded areas, where forestry workers have to cut roads through rough and rocky ground so that timber can be transported to the main roads. For this work drilling and blasting are necessary and to power the rock drills the combination of tractor and compressor has been found most useful in such undulating and mud-bound country.

Atlas Copco tractor-mounted compressors are well suited to road construction in bad country. Here a 100IT machine is powering a rock drill used in making a forest road to carry timber to a main trunk road

The 'Samecar' tractor being used (left) *for ploughing and* (right) *as a farm truck for carrying bags of produce*

Agricultural Chemicals and Supplies

For Reclamation Work

'Econal', being a mixture of two growth-regulating substances, 2,4-D and 2,4,5-T, is effective against a wide range of woody growths and herbaceous weeds. Specifically it is recommended for the treatment of ash, blackthorn, bramble, wild rose, buckthorn, elder, elm suckers, gorse, hawthorn, hazel and willow; it can also be used for the spot treatment of docks, nettles and thistles and certain other weeds in pasture and wasteland.

The distributors, *Baywood Chemicals Ltd.*, state that it is non-poisonous, non-corrosive and non-inflammable, though for obvious reasons it is not recommended for use near waterways. Being in the form of low volatile esters, however, the risk of vapour damaging crops in adjoining fields is reduced to a minimum.

'Econal' is a product of *Burt Boulton & Haywood Ltd.*, manufacturers of agricultural chemicals and intermediates.

Brushwood Clearance

Another formulation of the above mixture is 'Spontox', a product of *May & Baker Ltd.* The 2,4-D is to deal with such herbaceous plants as bindweed, docks, ragwort, sorrel and thistles, and in particular perennial nettle; and the 2,4,5-T is effective against many of the woody plants which invade neglected land, described collectively as brushwood — young birch, hazel, gorse and the all-entangling blackberry. Special stump-wood treatment is necessary for sizeable trees, such as oak, ash, beech and hawthorn, which are rather more resistant. Grasses are unharmed by aqueous dilutions of this chemical and they form a natural and manageable cover, once the overgrowth has been removed.

Since most scrub infestations differ in size and density of plant populations, it is not practical to measure areas or scrub accurately, *e.g.* when treating hedgerows and boundary growths. In all cases the material, diluted with water or oil, must be applied in sufficient quantity to drench both stems and foliage of the scrub growth down to ground level.

Reader Service

For further information on any item reviewed in this issue please use the card provided or write to:

Reader Service,
World Crops,
Leonard Hill House,
Eden Street, London, N.W.1
England

Organic Chemicals

A. H. Marks & Co. Ltd., manufacturers of agricultural chemicals and chemical intermediates, have produced a small brochure for formulators of weedkillers, giving details of the chemicals and formulations which they have in normal production. It gives the chemical name or names of each of 11 compounds and their diagrammatic representation, their physical and chemical specifications, and the forms and special formulations in which they are offered.

Mealy Bug Control

According to a report from Formosa, 'Sevin' insecticide, a *Union Carbide* product, has been successfully used for the control of the mealy bug, *Pseudococcus brevipes*, the vector of pineapple wilt, which can cause extensive damage in the plantations and result in whole fields becoming unfruitful.

In the course of work carried out at the Taiwan Sugar Experiment Station at Taitung it was found that 'Sevin' did not affect the plant, and in this it is superior to parathion, a material previously considered as the most effective pineapple insecticide.

Following the standard procedure of dipping young plants for three minutes in solutions of 'Sevin 50W' diluted 200, 500, 1,000 and 2,000 times, insect counts made on the following day and three and five days later showed control ranging from 77-93%, depending on the concentration of the solution.

Mushroom Spawn

Analytical control of the composts used in mushroom growing and the addition of supplements, when necessary, has been found to improve crop yields and produce mushrooms of better flavour, according to *W. Darlington & Sons Ltd.*, who have a world-wide reputation as producers of mushroom spawn.

Trials carried out at their experimental farm, supported by the analysis of hundreds of samples over a period of years, have shown that crop yields can be correlated with the total nitrogen content of the compost at the time of spawning. There is evidence, however, that not all forms of nitrogen are equally suitable and that a high level of nitrogen will only produce an adequate response providing other nutrients are present in an acceptable form and in adequate amounts.

Today this organisation bases its operations on the routine analysis of all compost used, and in 1960 obtained an overall average yield of 2.48 lb. of mushrooms per sq. ft.—a very high figure for intensive production by the tray system. Analyses are carried out in their laboratories not only for their own operations, but also for their customers, who include large commercial growers in Britain and overseas countries.

Worms in Livestock

Improved pastures make it possible to carry a larger cattle population and so a farmer is able to make better use of his available land. Unfortunately, this carries with it a greater risk of worm infestation.

In spite of the great strides that have been made in veterinary medicine during the past 25 years, the control of intestinal worms in farm animals has remained a major problem in all parts of the world. In the U.K. alone, with a sheep population of about 25 million,

approximately 2 million have died in a year as a result of worm infestation and it is estimated that a further 7 million sheep have been badly affected. This could amount to an annual loss of approaching £10 million.

Worms in cattle are no less of a problem. In addition to the loss of meat from the death of beef cattle, millions of gallons of milk are lost every year from this cause.

It is hoped that a new discovery by the Pharmaceuticals Division of *Imperial Chemical Industries Ltd.* will play an important part in eliminating such losses.

Work at Alderley Park Research Laboratories in Cheshire, England, has resulted in the introduction of a safe new drug, 'Promintic', which is highly active against the whole range of mature and immature intestinal worms which cause parasitic gastroenteritis, leading to gross loss of condition and even death in cattle and sheep. No detectable residues are found in the meat or milk one day after treatment.

This new drug is already available to the veterinary profession in the U.K. and other European countries and is shortly to be distributed throughout the Commonwealth.

Fertilisers for Cereals

New compound fertilisers have been developed at Levington Research Station. A mixture called *Fisons* 42 has a 16 : 9 : 9 ratio and this is recommended for general use in medium and low rainfall areas, where moderate amounts of both phosphate and potash are required, as well as high rates of nitrogen.

In those districts where the phosphate level is high, *Fisons* 49 mixture with a 14 : 6 : 20 ratio is more suitable. On chalk lands, which are very responsive to potash and often are very deficient in phosphate as well, *Fisons* 41, the 10 : 10 : 18 type, is better and this mixture should be applied at 3-4 cwt. per acre. On heavy soils, rich in potash, *Fisons* 33 is preferred, the ratio being 9 : 18 : 0.

In high rainfall areas lodging will be a problem and less nitrogen is required. Here a low nitrogen mixture, *Fisons* 45, is recommended. This has a ratio of 6 : 15 : 15; on the more fertile soils indeed a 0 : 14 : 28 mixture, *Fisons* 47, may be preferred in wet areas.

This pack of 'Rust-Anode' and 'Capalla' is suitable for a trial

The Demon Rust

Protection and prevention against rust is all-important in wet, humid countries. Metal gates, angle-iron posts, farm machines and horticultural implements can be badly affected if left to the mercies of the wet and the damp and their ' life ' is thereby considerably reduced.

One method of metal protection is by applying 'Rust-Anode'—a cold galvanising paint, which, it is claimed, will prevent rust indefinitely. It leaves a 95% zinc coating in the dried film. The manufacturers, *C. & P. Development Co. (London) Ltd.*, also produce 'Capalla'—a liquid which will act after rust has set in. 'Capalla' removes corrosion and leaves a perfect surface for paintwork. It also deposits a phosphate coat protecting the metal.

Food for Coconuts

The essential requirements of the coconut palm are rainfall between 60 and 100 in. per year, maximum day temperature between 75° and 85° and an open-textured soil to allow the roots to spread outwards and downwards. Plant nutrients are also an essential and if any element is lacking in the soil the deficiency must be made good by the application of fertilisers and manures; on the other hand, it may be wasteful to fertilise—it may even be harmful—if a mineral element is present in excessive amounts.

In order to determine the extent of a deficiency or an excess, much can be learned from soil tests for organic matter, available phosphate and also available potash. According to *Olin Mathieson Chemical Corp.*, such tests provide an inventory of the available plant food supplies and permit useful comparisons to be made between different soil types and between different fields even with the same type of soil. They divide the different types of soils into five categories for each of the three different soil components, making some 125 different combinations to describe the fertility status of each individual field.

This company invites growers to utilise their soil-testing service as a means of determining their most economical fertiliser programme and are prepared to send instructions and soil bags for sampling, according to their Agricultural Bulletin, No. 47.

On Manuring Pineapples

The pineapple is an important export crop of a number of tropical countries, but production is not profitable unless good quality fruits and high yields can be assured. It has been found that initially good yields can be obtained on the more fertile virgin soils, but yields quickly fall off if fertilisers are not used. On the poorer soils serious deficiency symptoms may be seen and uneconomic yields may be obtained even in the first year.

A recent report on pineapple manuring in what was till recently French Guinea (in West Africa) has been published by *Verkaufsgemeinschaft Deutscher Kaliwerke G.m.b.H.*

A 3 x 3 x 3 factorial experiment is described in which the fertilisers used were ammonium sulphate, dicalcium phosphate and potassium sulphate and the results are discussed, as well as the literature on the requirements of minor and trace elements—magnesium, iron, zinc, copper and boron. While the experience in one area cannot usually be applied elsewhere without modification, the paper offers useful suggestions for growers in other countries.

Forest Seeds

We were very interested to receive a price list of forest tree seed from *D. Meldrum & Sons*, of Scotland. This lists various named species of fir, cypress, larch, spruce, beech and Corsican pine and should be of interest to foresters and land reclamation officers.